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PENIKESE

A

REMINISCENCE

BY

ONE OF ITS PUPILS

Frank H. Lattin

"Yea, it becomes a man
To cherish memory, where he had delight."

Sophocles: *Ajax*.

1895
FRANK H. LATTIN, PUBLISHER,
ALBION N Y

DEDICATION.

TO

ALL

TO WHOM THE MEMORY OF

PENIKESE

AND OF

ITS MASTER

IS DEAR.

PREFACE.

The material of which this little volume is composed furnishes the apology which its author would make for its appearance.

It was begun in the summer of 1873, *at* Penikese Island; and has been retouched, constantly, since then, in the hope that it might, at sometime, be suitable for publication.

As it seems best no longer to withold its pages from the public—imperfect though they may be—they are now presented to you by

The Author.

PENIKESE.

CHAPTER I.

THE JOURNEY.

Penikese is a name ever to be remembered by me with the greatest of pleasure,—for it was there I passed some of the happiest hours of my life. I remember it all: the ground, with its undulating billows sodded with the sparing green and brown of low grasses or covered with sandy loam; the waters, with their rusty and smutty rocks rearing their jagged edges above the quiet expanse of the bay, or dashed against by turbulent waves; and the boulders, with their whitened faces, lying confusedly as they had been cast upon the wave-beaten beaches or strewn, like ancient sentinels, here and there about the fields;—I picture them all as if it were but yesterday. Then the buildings—the laboratories, the lecture-rooms, and the professors' house—(the last the most conspicuous of them all), mean in themselves yet dear from their associations,—I think of each and I love each. Ah! Shall I ever experience such free, such happy, such truly joyous hours again? But let me tell you how I happened going to Penikese Island, and what I saw, heard, and did there.

I had been sitting, one fine morning in early spring, by a cosy grate fire, perusing the columns of my favorite morning paper, when my eyes fell upon a short paragraph which instantly arrested my attention. It was the notice of a "Summer School of Natural History," and read as follows:—

"Mr. John Anderson, of New York, has presented to a body of Trustees, the island called Penikese, in Buzzard's Bay, for the site for a Summer School of Natural History, to be in the charge of Professor Louis Agassiz, whose purpose is to give free instruction, to teachers of the sciences, in correct methods of study in this most important branch of education."

The subject was one of peculiar interest to me, and, as I read, visions of what a grand opportunity would thus be afforded to study Nature so filled my mind, that they took complete possession of my senses.

Natural History was always and is now for that matter, my favorite study; one might almost say I had been born and bred a Naturalist. From my earliest recollection I was often made supremely happy by the present of a robin's or a sparrow's egg, or some other similarly common natural object, from the bounteous collection of a friend. *To me*, it was untold gold. If an egg, I would hold the delicate shell in my fingers, slowly and carefully turn it from side to side, examine its glossy surface and perfect proportions, look at the holes in its extremities to see how thick the shell itself might be, and often—though I hardly dare to tell it for fear of being laughed at—wonder how much wind had been required to expel its contents. From my first egg I soon reached my hundredth—and more. Then I formed the plan of making a general collection in all of the different branches of Natural History which, carried into effect, was successful beyond my most sanguine expectation. Thus, at an early period of my life, in the full glow of scientific ardor, a short and almost insignificant newspaper paragraph—insignificant, perhaps, to all save a few—appeared at once to open to me a possible path to scientific fame and attainment that, in my youthful ambition, seemed limitless. The opportunity and the Master, the best that the country, nay the world, then afforded! I immediately applied for admission, and received, by return of mail, an answer from Professor Agassiz himself—in

his own hand-writing and with his own autograph attached—accepting me as his pupil and inclosing full instructions. Thenceforward I could eat, drink, think, and dream of nothing save Penikese. Oh, how I longed for the time to come when I might journey thither.

At length the day for my departure arrived. How eagerly and with what a glad heart I packed my trunk and valise and started for the nearest railroad station. My friends must certainly have thought me hard-hearted as I left them, shouting my good-byes from the top of the coach to which I had sprung, with as much apparent joy as if a rich Uncle had just died and bequeathed me a fortune, and I was forthwith going into the possession of it.

I was soon on board the train and travelling toward my destination. How slowly we appeared to move. It seemed as if I might easily have outdistanced this or any other train, today, on foot,—and yet we must have been going at a fairly rapid speed. Having composed myself as best I could I found amusement, for a time, in watching from the window, as they passed in quick succession, the fields, covered with curling stalks of young grain or downy with soft heads of timothy and other grasses; the new-mown hay lying in loosely scattered heaps or gracefully-curled swaths upon its bristling stubble; or, here and there, a solitary person still working at his daily toil. Close by, in a nearer portion of one of the meadows, a tall, lank individual was standing on an immense load of hay, upon which he was stowing away fork-full after fork-full as it was pitched to him by an equally tall, lank individual, who was standing on the ground below; while a fine pair of blacks stood, in lamb-like attitude, just in front of the load. Another moment, and, frightened by the noise of the train, the blacks were scouring the fields, like a pair of wild prairie mustangs, bearing with them the fast-decreasing pile, —while one of the tall, lank individuals was assisting the other to rise from the ground. Then we dashed

by to where a number of coatless workers were raking the hay, with the utmost diligence, into small, rounded piles, that it might the more easily be pitched upon the cart which should arrive for it. Past these we went, to a large swamp dotted here and there with hummocks where grasses, huge, rough brakes, and delicate ferns grew in luxuriance and abundance; and upon some of them, nearest the track, I could even distinguish wild flowers rearing aloft their slender stems and delicate heads, and tell the species of many of them. Then we came to a long, thickly-wooded stretch, where a forest of trees, large and small, extended far along the track on either side, arching their tops and intermingling their branches as if they would bind us with their mystic spell; but, like a prisoner who would not be bound, we dashed through and by them, only to emerge into the light of still more fields, and still new scenes. Weary with gazing at these, I then, tried to count the telegraph poles as they appeared to whiz by us, or watched the wires as they travelled, or appeared to travel, now up and now down my window, as the height of one pole above another or the inequalities of the road-bed showed themselves. Thus amusing myself, now with this scene now with that, we journeyed on, hour after hour, until, at length, the scene materially changed and salt water put in its appearance. Then the houses began to thicken, and the smoke and confused arrangement of a big metropolis loomed in the distance. Presently the train, after passing through a perfect labyrinthine maze of houses, streets, archways, and narrow alley-ways, stopped, and we found ourselves safely landed at the "Hub of the Universe"—Boston.

From Boston we left directly for New Bedford, where we arrived about seven o'clock that evening and immediately engaged rooms for the night. Here the hotel was alive with excitement. Carriages were constantly arriving with guests,—mostly students like ourselves, and bent upon the same errand. Men,

both old and young, were going to and fro in all directions; porters, carrying huge trunks upon their shoulders, were continually running against the passers-by, or stumbling about under their loads to the seeming peril of a bevy of small boys, who were in everybody's way; and waiters, with white aprons, nicely balancing upon the tips of their fingers large trays filled with dishes, were hurrying here and there in apparently endless confusion. The clerk's desk occupied, very nearly, the centre of the room or long hall in which we found ourselves upon entering the hotel,—hence, to the general confusion was added the bustle and crowd attendant upon the registering of our names, and bell-boys showing people to their rooms. Nor should we forget the numerous boot-blacks, who acted their part in the scenes about us. To get my supper, and find my room, and hasten toward the land of dreams, was the work of a comparatively short time,—though it seemed hours to one who was so tired as myself; but it was at last accomplished.

The next morning I awoke very early, refreshed both in body and in mind with my night's rest. It was too soon, as yet, to arise; and so I lay and watched the dancing sunbeams which, through the blinds of my half-closed windows, shone and played merry pranks upon the opposite walls of the room, while the trees outside, stirred by the light off-shore morning breeze, sent shadowy images of fantastic shape moving, here and there, among them. One immense, dumb-bell-shaped sunbeam amused me greatly in its attempts to smash a fine vase upon the mantle near by. It would dash at it with unerring accuracy and terrific impetus, only to stop short, within a few inches of it, and return immediately to its former position, leaving the vase wholly untouched. Above this beamed another, now intensely bright now quite dim; and, farther on, two small, active little fellows played hide and seek behind each other, so that the two became one and the one two again each alternate

moment. At length, tired of watching the bright, roguish sunbeams, and animated by a lusty-sounding gong, which seemed to be beaten directly in front of my door, and, consequently, for my express benefit, I sprang from the bed and quickly dressed for breakfast. After the morning's meal I hastened to place my baggage in the hands of the porter whose duty it was to take it on board the little steamer, which was so soon to convey us to our island home, and then started for a stroll about this quiet, quaint, old-fashioned city,—there being yet several hours to spare before our departure.

I will not attempt to describe New Bedford, as I was in it for so short a time; but I wandered along one or two of its principal avenues, admiring the noble dwellings with their rich, handsome lawns, which, like miniature parks, fronted the streets at the farther end of the town, and then, returning, entered one of the small, dirty by-streets that led to a neighboring wharf, to which I directed my steps. What a sight here met my gaze. Vessels of all kinds and sizes, from full-rigged ships to perfect swarms of boats and dories, lay about me in every direction. It seemed as if there were thousands of them, though doubtless barely as many hundreds. Two full-rigged men-of-war, which had just arrived from France, as I learned afterwards, anchored some distance in the bay beyond the rest, seemed like monstrous guardians of whaling vessels, steamers—large and small—brigs, barks, and schooners of all sorts and kinds. Vessels, almost new, shone resplendent with recent coats of bright paint above the rest, but most were so old and worn that you could almost have believed them to be veritable "Noah's Arks." I could not but admire several beautiful pleasure yachts that lay at anchor in the bay. I could see them, rolling about from side to side, showing their smooth planks and well made forms, and bending their masts gracefully in the air or dipping their handsome prows far into the waters which surrounded them. How I en-

joyed the scene. It seemed to have a fascination for me that was irresistible.

Then I turned my attention to the wharf itself, which, like most of the others I could see about me, was built far into the water. It was covered with heaps of boards, new and bright, old and dingy, some immense plank, others thin deal,—and one very old pile came tumbling down with a noise like thunder, as I accidentally stumbled over several pieces which extended far beyond the rest; with barrels, apparently of oil and tar, whose blue sides and red ends, thickly streaked with an abundance of the same material as that composing their contents, showed up on all sides; and with piles of old iron, ballast-stones and spars and masts of vessels; all of which, with many other things of a like nature, lay scattered everywhere around in endless confusion.

At the farther end of the wharf were a group of dirty, bare-footed little urchins, who were amusing themselves with all sorts of doings,—one could, at first sight, barely distinguish them from the brown, dirty logs or barrels amongst which they played, and whose hands and faces, as well as their clothes, seemed equally bedaubed and grimy. Some of them were playing at marbles, while others, mere lookers on, were lying about in the mud and dirt, like so many flounders off the pier head at low tide, watching the progress of the games. On a low, narrow stairway, leading to the water, sat several youthful fishers, who appeared in high glee over four or five poor little fishes, barely as many inches long, which they had succeeded in catching with the most primitive pole, hook, and line imaginable, and only after long and patient waiting, doubtless, upon their part. On the very end corner of the pier, a most wretchedly dirty, ragged, and diminutive urchin was amusing himself by throwing stones at the numberless small chips of wood which were tossing about upon the rippling waters beneath him, or occasionally "skipping" some particularly smooth, flat pebble, which

he had selected from the loose earth scattered about the pier around him, to the great delight of a still smaller specimen of existence, who jumped about and clapped his hands, as he counted the skips, most gleefully. It was a characteristic scene for such a place, and I watched it all with idle interest whilst waiting for the whistle of the "Helen Augusta" to summon us on board.

From this scene I wandered about amongst the old whale ships, which, like huge ghosts, reared high in air their whitened spars and exposed their bleaching sides to the hot sun, or lay, in various postures, awaiting, as the case might be, the hands of time or the renorvating touch of busy workmen, while upon some the carpenters were already at their labors. Then I walked up and down the narrow streets close by the wharves; I visited many of the shops and small warehouses; and amused myself in every way possible until, at length, aroused by the shrill scream of the tug-boat, I hastened to the scene of hurry and confusion consequent upon our starting for Penikese.

On arriving at the wharf, where the tug-boat lay, I found it literally one mass of moving heads and wagon-tops. Everything appeared to be in the wildest disorder and everybody to have lost their senses completely,—at least judging from the crazy manner in which people persisted in getting in each others way; nor was the confusion less noticeable on board the steamer, which was small and crowded. There were trunks, hat-boxes, valises, boxes, crates, and baskets; general kitchen-ware, cooking utensils of all sorts, and furniture mixed with Natural History stores and apparatus; all lying tumbled together so promiscuously and occupying so much room, that, in company with several others, I vainly wandered seeking a place of repose and momentary quiet from the human storm which everywhere surrounded me, and was fain almost to envy even the dirty little urchins, whom I had so recently left, their peace and quiet.

At length comparative calm reigned, and I found a moment in which to look about me, and to note the forms and faces of those gathered upon the deck and in the waiting-room of our little steamer—all of whom were eager for her departure. What a jolly set they were, these strange forms and faces! Old men and young men, elderly ladies and young, fair maidens. A varied group indeed,—yet, for all, it looked like an agreeable one.

When the second whistle sounded, a particularly shrill and startling one it seemed to me, what a scene ensued;—what a profusion of hand-shakings and good-byes were given and taken upon every side; slowly the tide of humanity poured down the boat's side and on to the wharf below. And now the steamer had completed its load. The dull beat of her paddles and her heavy column of black smoke announced that we had left the pier and were on the move. One by one the wagons started leaving the wharf; one by one the scattered groups of people turned from the dock and followed; then, finally, wharf, people, and wagons grew further and further away as, with regular puff and plunge, the little "Helen Augusta" steamed quietly away from the dull, hot city, and out into a clearer atmosphere—upon the fair, heaving bosom of the bay.

CHAPTER II.

Agassiz and Penikese.

Buzzards Bay! What a glorious mingling of land and water! Well worthy its illustrious discoverer, the famous Bartholomew Gosnold. In fact, both our little Penikese, and its larger neighbor, Cutty Hunk, have contended successively for the distinguished title of "Gosnold's Hat." Adown the broad bosom of this bay we glide. The passengers crowd the prow and stern of our small craft, to drink in the delicious draughts of cool, fresh air, that fan the cheek into fairly blushing at itself as it tells, so plainly to all around, its secret joy at this occasion: and this is the group most of whom are to bear me company, during a willing summer exile, in an enterprise which is to unite professor and pupil, heart to heart and hand in hand; hearts devoted, and hands ever ready, to do the work which the Master shall assign them.

Our sail to Penikese was a very pleasant one,—and now mark our surprise: As we approach the wharf, there stood Professor Agassiz himself, who had thus anticipated our arrival, with beaming face, ready to welcome us; and his warm, enthusiastic shake of the hand, and gentle, winning words, which were ever new and fresh to each one, sent a glad thrill through each heart. How proud he looked. How like the kind, benignant father to us all that he indeed was.

After the handshakings, he lead the way, up the old lane or cartpath, to the place of meeting. There all seated themselves save Professor Agassiz, he alone remained standing. What a sight! What a

scene! Would that some canvas might contain that picture.

The Hall, or place of meeting, was an old barn—still retaining its ancient, barn-like appearance without though entirely renovated and somewhat remodeled within. Great pains had been taken to leave its side and rafters as they had been, and bare,—yet perfectly clean. By a partition, was made a small, square room, at the farther end of which were ranged the chairs in which the pupils and company sat; in front was a long table, extending nearly across the room, around which the more highly honored guests were placed; behind and near the center of the table, stood Professor Agassiz, with head uncovered—with the fingers of one hand barely touching the table with their tips, and the other hand within the breast of his coat. In a moment all were silent:

> "Then the Master,
> With a gesture of command,
> Waved his hand;"

and Professor Agassiz addressed us:

"My friends!" he said, "you know not what a pleasure it is for me to meet you all here today! I have looked forward to this as being a very happy event in my life, and I am not disappointed; but, before proceeding with our business, let us look to the giver of all our good things in thanksgiving. I know not any of you, therefore cannot feel free to ask of any of you that favor which I otherwise should do. I will ask you all, therefore, to join with me, for a few moments, in silent prayer." Bowed heads and silence responded to the call, as all joined in that solemn occasion,—and the waves dashing upon the rocks, seemed like the utterances of those unspoken words—while a thousand white-winged gulls, upon noiseless pinion, filled the air, and seemed like messengers from Heaven, awaiting only to catch the spirit of those words that they might bear them upward.

After a few moments the professor addressed us. He thanked us all for coming to meet him on that far off, lonely island; and he thanked himself for being able to be present; he thanked the kind giver of the island and its endowment, Mr. Anderson, for himself and for all, that he had been moved to such a generous bestowment of property and happiness to the community; and he thanked the friends there present at its opening for their sympathy with the plans of the trustees for the institution, as well as for their hearty co-operation in furthering those plans: Then he thanked God for his goodness to them all. After this, speeches were made, and many prominent public men took part in the tributes of praise that were bestowed freely upon all interested in the school,—whether teachers, pupils, or any that sympathized with the grand work thus initiated,—and the company broke up, happy and pleased with their first public introduction to Penikese.

Our first day at the Island, thus it began! It was intensely warm, and the sun shed down its almost vertical rays upon a soil, dry and sandy, with scanty vegetation, though with a liberal supply of rocks and boulders, which were scattered everywhere about the place. Viewed simply in itself, it was a most unattractive spot, and at first I could scarcely persuade myself that I should enjoy my stay here,—yet for all the unattractiveness of the place, a secret something filled my mind with pleasant thoughts, and I found, even in the rocks and boulders, and the dry, sandy soil, with its occasional patches of green, a solace for all the objectionable features of the situation. We had met together upon this desolate island, a band of brothers,—stranger brothers as yet, to be sure,—but, although still unacquainted with each other, a common bond of sympathy was drawing us nearer and nearer one to another—master and pupil—in a friendship that was to last a life time. Thus, at the very beginning, each rock, each grain of sand, each blade of grass even, was invested with an interest

which increased daily as the Master's hand directed our attention, and his thoughts our thoughts, to the—to us at least—hitherto unimagined wonders of the objects lying everywhere about us. Drawn by a common union of mind, sentiment, and purpose, there had met together, from all parts of the United States, two score and ten specialists—old and young, men and women—teachers to be instructed of teachers. All faults and differences were forgotten, if indeed there were many to forget, by mutual consent, as each worked for the common good of mankind. No wonder that the influence of these persons is felt today everywhere, throughout the length and breadth of the land, as they reflect the light of that wonderful man, Louis Jean Rudolph Agassiz. Love makes even duty a pleasure. One short hour and we loved our instructors and our companions we loved our little sea-girt island,—for all its barrenness. We looked upon everything about us with a sort of reverence. All had a meaning now. Do you wonder that I remember those days as some of the happiest of my life? But active preparations for dinner are going on, it would amuse you to see them.

Our first dinner had, for the most part, been prepared in New Bedford, and brought over with us in the boat. The room in which we were to dine was almost square; and the doors opened near the centre of one side of the building and next to the partition, which separated the dining-hall from the kitchen. Close to the windows, upon either side, were two long tables running lengthwise of the hall, which were intended for the students; a third table, running crossways and with its ends directly in front of the entrance, was for the use of the professors and their families. There were rough, homely chairs placed evenly and closely to the white table cloth and neatly set tables; the dishes were plain, though not coarse; and the food simple yet healthful. All things seemed exactly fitted to the occasion. Were we inclined to grumble a little, at first, at both our food and our

accommodations; we who had been accustomed to the best? If so, nobody complains now,—when professor and pupils share alike. The Hall was crowded that first day. As soon as one had finished, new plates were laid and another occupied the place; but our waiters were so well trained, that we scarcely had occasion to remember this as a first meal. Although taking some time to accomplish it, our party were at length all well provided for; and the visitors, after having given and taken most hearty and cordial adieus, hastened on board the little steamer once again, and were soon on the way to their respective homes. The school had been advertised to begin upon a certain day. Up to within a few weeks of its commencement, almost nothing had been accomplised saving the transfer of the island from Mr. Anderson to its trustees. The friends of the institution were despondent. The day for the opening arrived, everything was ready. The enterprise was a grand success.

It was with a strange feeling that I watched the "Helen Augusta" as she left the wharf, and steamed far out into the bay. I had taken my station in the old fort, upon the highest part of the island,—it looked as if it might be centuries old, perhaps built by the famous Bartholomew Gosnold himself, the early discoverer of these regions; and from thence I watched her as she grew farther and farther away,—then her hull and smoke stack became fainter and fainter; then a long line of smoke, hanging heavily along the horizen, with a small, dark speck just beyond it; these, too, soon disappeared. Then, for the first time, I realized that school had begun.

After considerable delay, our baggage was transferred from the wharf, in the most primitive manner imaginable—by a yoke of oxen, and an odd, old-fashioned tip-cart,—to the door of the dormitory; then came the rush for claiming property. To have seen the scrambling, one would hardly have believed this to be part and parcel of the quiet orderly, assem-

bly of but a few hours previous. How each box, bag, and trunk found at last its respective owner is a mystery that I will not attempt to explain,—yet it was at last accomplished, to the complete satisfaction of all parties.

Our dormitory, though a strange looking affair, was most admirably adopted for the purpose for which it was intended. It was a long, two-storied building, standing, if I remember correctly, northeast by southwest. The upper floor was, as yet, in an unfinished condition,—though the carpenters were now busy completing it; the lower room, like the upper, long and narrow, was divided into two compartments, of about equal length, by means of sailcloth suspended from a cord running high up across the room. Of these two apartments that facing the bay was occupied by the ladies, that facing the island, by the gentlemen. The inside arrangements were similar in both.

The interior of the men's apartment was arranged with a long aisle extending from the door through the centre of the room, upon either side of which were ranged a dozen or more cot beds. At the foot of each bed facing it, with but a narrow passage between, stood a bureau; and a little to one side of its head a small washstand, with its accompanying necessary furniture. A chair, and a simple tallow dip and tin candlestick, with a few matches in it, completed each person's outfit. Our trunks were placed behind our bureaus, and our valises anywhere that room could be found for them.

We were obliged to pass our first night almost in the open air. The window-sashes were without glass, and the cool breeze swept through the long room unrestrained; but it was not uncomfortable, and we did not mind it greatly. It was late in the afternoon before I had unpacked and satisfactorily arranged the books, clothing, shooting and other materials which I had brought with me. When it was at last accomplished, I threw a shawl over my bed, put on my

slippers, and lay down to rest. I had placed the pillow at the foot of the bed, that I might the better drink in the delightful air and the broad ocean scene which spread itself, in all its freshness, before me. What a lovely view it indeed was! My eyes rested upon a gently sloping bank of the most delicate, velvety green—appearing the more beautiful from the scantiness of the surrounding vegetation—extending to the sea itself, which rolled long lines of low surges lightly toward it. Further on, dancing billows and light whitecaps played merrily in the sunlight of the departing day. Then the surface of all the water was tinged with the most fascinating shadows from the dark, fleecy clouds above; they changed constantly; yet their very changes only made them the more beautiful. In the far distance, sail after sail would appear and disappear as a mere speck of light, visible only by long watching. Now a sail would shine, white and clear, before my very eyes,—another and another, farther on; the shadows had hidden them before. There were nineteen of them in all—and, in the distance, two large, three-masted schooners. Then a steamer left a long, dark haze of smoke upon the sky—poking its tall, black stack into sight for a moment only to disappear, like many of the sails, in a long umbre cloud which lay against the horizon. At last satisfied by the scene, and fanned by the delicious atmosphere wafted in at my window, laden with that peculiar salt sea air, so intoxicating to a true sea lover, I fell asleep, to dream that I was far out upon the ocean, in a small schooner, and being softly rocked to and fro from the "Nest," high up on the foremast, by the winds and gently rolling waves.

I do not know how long I slept, but I awoke with the most delightfully refreshed sensation that one can imagine, and ready for almost anything that should present itself. I will not here enter into a discussion of the question, as to how much sleep the human frame needs, at what times, and for how long a time; for I am a firm believer in the theory, that

nature herself will not only inform us as to when we should sleep, but will also determine for us how long we should sleep. So far, at least, my theory has never failed me. And now, after a most refreshing slumber, I awoke and returned once again to the realities of life.

Upon arising, I found my companions still busy arranging their effects. Though everything seemed in apparently the most endless confusion, with everybody and everything in everybody's way, there was not a person present whose face did not glow with happiness, and the most eager and intense enthusiasm. Each seemed specially to have partaken of the spirit of our leader, who was everywhere,—encouraging, aiding, and directing. The workmen were completing their unfinished labors, and he was guiding them. What a sight to watch him! He was neither haughty nor reserved, as many who were unacquainted with him would fain have had us believe; but he mingled freely with all. His genial face, and the sincere, earnest tones of his voice, attracted everybody; while his approval of the work already done, and the directions for the furtherance of his plans, were given as if to equals rather than to servants paid to obey him,—nor did I hear a word of complaint spoken against Professor Agassiz for any cause whatever, by anybody, while I was upon the island.

CHAPTER III.

Penikese and Agassiz.

Supper time at last, our second, though really our first, meal at Penikese. The cooks had come to the island in the same steamer that we ourselves had arrived in, and were hardly yet fully established in their new quarters,—one could hardly expect everything to be perfected at once. It was no easy task, that of opening and arranging boxes, bags, and barrels, and sorting and storing their contents. Then preparing the food for the table, with the limited supply of culinary articles yet at their disposal, would have taxed the patience of much more angelic individuals than those same "colored brethren" were supposed to be; but the supper, like the dinner, *was on time*,—as was *everything* that Professor Agassiz superintended.

There is a trite old Latin adage, that reads, "Fames bene condimentum est," better known as "*hunger is the best sauce*,"—and I do not believe that there was one amongst us that night who did not fully enjoy all that had been provided for the occasion, notwithstanding the difficulties under which it had been prepared.

After supper "the school" scattered about the island in every direction, singly or in groups which were all soon lost sight of behind the hillocks and surrounding rocks. As to many the position and general appearance of Penikese may be unfamiliar, I will try to give you a glimpse, though a very imper-

fect one, of its location, its surroundings, its beauties, and its attractions; yet how I wish that you might have seen it as I saw it, and known it as I knew it.

Penikese Island is situated almost directly south of New Bedford, though perhaps inclining a few points, as the sailors say, to the westward, and is fourteen miles from land. About three miles south of it lies Cutty Hunk, which was, at the time our school first opened, owned, in part at least, by a New York club, the members of which spent their summers there in fishing, hunting, and in yachting. About the same distance from Penikese, and east of Cutty Hunk, lies Nashawena. It is an immense island, and is nearly fourteen times the size of its little near neighbor, our Penikese. Still farther eastward lie Pasque, Naushon, Nonamessett, Uncatina, and the minute Weepecket, ranged, with the exception of the last, one after another, in a crescent, and the last separated by only a narrow strait of water from Wood's Hole, as it is on the maps, though someone has perverted it into Wood's *Holl*, the extremity of the mainland in this direction. The "old-timers," of New Bedford and its vicinity, arrange the names of these islands in a little verse which, they say, enables them the more easily to remember them. It is as follows:

"Naushon, Nonamessett,
Uncatina, Weepecket;
Nashawena, Pesquinese,
Cutty Hunk, and Penikese."

Of course we cannot see all of these islands from our school; for, unless the day is unusually fine, we see very little excepting old ocean,—calm and glassy as a mirror, or tossing, tossing, tossing, all the day. Yet the air is always delightful, we have no smothering hot days, there are no mosquitoes to keep one within doors of an evening, and, after a steady day's and evening's work—perfect rest!

Penikese, itself, is an hourglass-shaped little islet, and, in general appearance, though evidently not in size, "Gosnold's Hat" indeed, —with all its pokes and crinkles, and just as its owner, having grasped it in his hand, had tossed it into the broad, placid bosom of the bay. When I said that it was fourteen miles from land, I should have said, that it was fourteen miles from New Bedford,—for it is much nearer the little village of Quansett, directly northwest of it; and when I said that it resembled a hat, I should rather have likened it to two hats placed side by side, the one smaller than the other, the smaller one lying nearest to the mouth of Buzzard Bay, and both running parallel to the shore. Little Gull Island is a minute near neighbor. Thus are we situated.

The beauty and attractions of Penikese Island are not, at first, apparent; yet no lover of nature can look upon green slopes, browned and whitened rocks, plains and hillocks, or the variety in contour upon our sea-girt, rocky island, without seeing in everything both beauty and attractions. To us, it is a Morgana's fairy isle,—with always something new to engage our attention, and wherein we would willingly remain our hundred years or more, and never grow old. We wander about it. On every crag the sea swallows build their nests, and in every bank the bank swallows dig their holes wherein they lay their eggs and rear their young. The turnstone and the plover linger all day among their dear pebbles, and the sandpiper brings forth its nestlings amidst the sparce vegetation of the sanded beach above. Birds, birds, birds everywhere! The ground, the air, and the waters, abound with them; and the sound of their notes is incessant. The cricket and the grasshopper sing from their grassy coverts, and all nature smiles. These are some of the beauties and attractions of Penikese. Thus did we, I, all of us, find it on that first night, as we strolled here, there, every-

where, about our little pleasure-garden, until the darkness closed about us and the sea sang of rest.

Well do I remember that first night's stroll about the island. I was alone. No, not alone, for all Nature was with me, and I communed with her as with a fellow being, ever by my side listening to my youthful fancies, and, sage like, propounding at every step questions which I might never fully answer: Questions of the birds of the air or of their nest, eggs, or young, close by; of the plants, lichens, and mosses of the rocks and ground about me; of the very sand, earth, rocks, boulders, and ledges, at my feet; or of the fishes and marine life of great ocean—so bounteous, so mysterious—before me. There was no need for us to search long for "specimens;" for had our school lasted two years instead of two short months, I fancy that there still would have remained much that was new to have been searched for, nay, to have been found. I would that I could recall all the weird fancies that came to my mind that first night, as I wandered amongst the darkening shadows of those rocky sentinels; as I peered over precipitous crags, or mounted to the top of some rocky height from which to view the fast dimming outlines of the lapping wavelets of the bay; or as, in some cosy corner, I reclined and listened to the murmur of the waves, and peering into the surrounding darkness, tried to distinguish something, where I knew there was nothing, in the vast beyond. Halcyon days, indeed! Halcyon summer evening, were they! Do you wonder that I look back upon them with pleasure?

As to our daily work, the routine for one day was much the same as for each successive day that we were upon the island, and we soon learned about what to expect. There was the breakfast horn, the breakfast, and the lectures, which all or part might attend, occupying that part of the forenoon not devoted to exploring, collecting, or dissecting; and then dinner time. After dinner a similar routine occupied

the afternoon until tea time. Sometimes we had a lecture after dark, while we often dissected by candle light. Thus we were never idle, always busy, always learning! How softly and how pleasantly the time passed; and far into the night we remained rewriting our daily notes.

Professor Agassiz's own method of work was peculiar, and differed from that of any of the other professors, though many of them imitated him as closely as they were able. *He* never assumed superiority over his pupils; never attempted to annihilate them with his wisdom; but yet, *being* superior, he took the place of a brother as well as that of a teacher. As brother and teacher he was a living illustration of the truth of mottoes which, from time to time, he tried to impress upon his pupils. "If you wish to learn," he would say, " there must be no question of dicipline in the class room,"—and unruly members were dismissed at once and without mercy. And, again, "Never be afraid to say 'I do not know.'" He would give us an object, and oblige us to study that object alone for days, until we had ascertained the simple and yet plainly evident principals of classification involved in its form and proportions. Rarely would he tell us anything about any specimen which he had given us to examine; but would question us day by day until we had told him the history of the species, as we were able to discover it; or until we were obliged, from the mere fact of finding nothing else to say, to give him the very answer for which he had originally given us the specimen. Until we gave him this answer, we were subject to the closest and most continued scrutiny; whether the time were hours or days, made no difference to him. I once discovered, amongst the remnants of sand and debris in my collecting net, a most curiously speckled, shell-like or seed-like object, which, seeing Professor Agassiz near, I hastened to show him. In the eagerness of the moment I asked him what it was. He looked at it intently for an instant. His face became

long, then wore an anxious expression, as he took from his pocket a small lense and hastily began to examine the object with the utmost care. Gradually a smile spread over his features, then he fairly laughed as he closed the lense and replaced it in his pocket, and handed me back the specimen with the remark, "I will give you three weeks, Mr. ———, in which to find out what it is." He then proceeded with his own business as if nothing had happened. The following afternoon I accidently discovered that my specimen was the cornea of a crab's eye, which had accidently become detached from some specimen I had captured, and which had remained in the bottom of the net after its owner had been removed. "That man could get more out of me in three week's time, than anybody else I was ever under in three years," was the remark of one of his pupils to me. Why! For in seeking *one* point, he forced from you one hundred that you had not even suspected as existing before you began your search for it, all following each other as a natural sequence. He was a wonderful man, with a wonderful receptivity and extensive memory, and a wonderful capacity for teaching others; but words fail me in endeavoring to render a just estimate of his character.

CHAPTER IV.

The History of the School.

I have now introduced you to Penikese. Before unfolding the plan of our work there, bear with me a little, while I go back and rehearse somewhat of the history of the school thereon, since it is very properly a part of our little volume.

Before starting for Penikese Island, we had each of us received a variety of letters and circulars, both printed and written, relating to and descriptive of the manner in which the school was to be conducted, and the line of study to be pursued there. From the nature of the case, I judge that all of the scholars received similar information. I do not possess all of these valuable papers, I only wish that I did, but those which I have, embrace the most important ones and are fully sufficient for our present purpose. We will open the package and select those which seem most clearly to convey to us a knowledge of the intentions of the founders, and of Professor Agassiz, regarding both the school and its pupils.

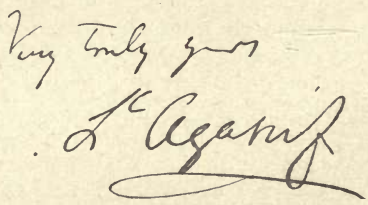
The first letter, in order of time, appears to bear the stamp of Professor Agassiz's personal dictation and so I will quote it entirely:

Cambridge, Mass.,
May 18, 1873.

Dear Madam:*

Applications for admission to the Anderson School of Natural History are pouring in at an embarrassing

rate. Among the latest applications there are some which seem to me to have higher claims than preceding ones. I therefore appeal to all who have already been admitted to state again how important it may be for themselves, or for the cause of education in general, that their individual case should be recognized, as fifty persons only can be accommodated in the laboratories of Penikese. To some, admission next year may perhaps be quite as useful as this year. Any failure to answer this request within a fortnight will be considered as a resignation.



The above is Professor Agassiz's autograph. The circular to which it is appended was a written one, and was, I believe, the very first that was sent to the successful candidates. The letter of acceptance being (at least my own was), a personal one from the professor himself, such at least is my present impression. You may be quite sure that there was no "resignation" recorded to *my* name, and I answered the communication with so much dispatch, and withal so appealingly, that the return mail brought me another from Professor Agassiz himself, short and to the point, telling me to have no fear for or doubt of my acceptance as a scholar of the school at Penikese,

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* This letter was addressed to a young man whose Christian name was so similar to a name often applied to a lady that the applicant was supposed to be such.

"even though another questioning circular should reach you shortly."

During the early part of the winter of 1872, Professor Agassiz had contemplated opening a school, of similar character to that which Penikese proved to be, on the Island of Nantucket or some point upon the mainland, perhaps at Wood's Hole. He had even printed a circular which advertised a "Course of Instruction in Natural History, to be delivered by the seaside, in Nantucket, during the summer months, chiefly designed for teachers who propose to introduce the Study into their Schools, and for Students preparing to become Teachers." He had selected his corps of instructors and lecturers, and assigned them the branches which he wished them and which he saw they were most fitted to teach: It contained the names of N. S. SHALER, COUNT L. F. de POURTALES, DR. H. A. HAGEN, A. S. PACKARD, F. W. PUTNAM, J. A. ALLEN, SPENCER F. BAIRD, THEODORE LYMAN and many others. By the donation of Mr. Anderson, the location of the school was now definitely settled; and the work pushed forward with the greatest vigor. It was this same advertisement, in substance, that was sent to the pupils and friends of Penikese.

The work of preparing Penikese for the school to be held there, was commenced on the 20th of April, at which time a site for the buildings was selected and a general plan of operations arranged. In showing the dispatch with which Professor Agassiz consummated this—as in fact he did all of his plans—his grand, culminating life work, a few words from one of his reports says: "The plans were at once completed, and by the 16th of May the contract was made for the building. On the 28th of May the timber arrived from Maine in New Bedford. There the building was framed. On the 5th of June the first cargo reached Penikese, and the first building was raised on the 14th of June." We have seen, in a previous chapter, how the school began *upon the*

day on which it was advertised to begin, July 8. Incredible dispatch! Provident accomplishment!

The same day that the timber for the buildings reached New Bedford, the following circular was issued:—

"Museum of Comparative Zoology,

"Cambridge, Mass., May 28, 1873.

"My Dear M.....

"In attempting to organize a School of Natural History upon an entirely new plan, I assume a grave responsibility which must, in a measure, be shared by those who may seek instruction there. To avoid disappointment, I feel it my duty to say what I propose to do, that those who may not like my course should be able in time to give up their intention of placing themselves under my direction. It is proper, also, to add, that the applications for admission are very numerous, and exceed so much the accommodations of the place as to embarrass me greatly. I must make hard work a condition of a continuous connection with the School, and I desire particularly to impress it upon the applicants for admission, that Penikese Island is not to be regarded as a place of summer resort for relaxation. I do not propose to give much instruction in matters which may be learned in books; nor do I wish books to be read during the summer session of the School on Penikese Island. I want, on the contrary, to prepare those who shall attend to *observe for themselves*, that they may hereafter be able to make the most of their opportunities for study in nature, in whatever part of the country they may reside, as there are hardly two adjoining school-districts in which the same objects may be collected for examination.

"It will no doubt appear, to many, a wearisome process to sit for hours before a specimen without any but a very general direction what to do with it. I would, therefore, advise all those who wish only to

be taught Natural History in the way in which it is generally taught, by recitations, to give up their intention of joining the Anderson School.

"My plan will further imply the obligation, on the part of all present, of making special collections to carry home and use as a basis for the teaching others, in the same way, I propose to teach myself, with the assistance of many of my scientific friends.

"My object in adopting this course is, not only to give what I consider to be the best instructions, but also to show how teaching should be conducted by competent teachers.

"I wish it were possible for me to state at this early day what the expenses for board are liable to be for the season. As there is no public house upon the Island, everything must be provided for by private arrangement. I can only say that it will be furnished at cost, at the most economic rate; and that no tuition fee is to be charged.

"The course will probably open in the first days of July.

"Yours Very Truly,
L. AGASSIZ.

"Should you be prevented from attending please inform me early, as there are many who wait anxiously to fill vacancies. L. A."

This was, doubtless, the "questioning circular" before referred to, and, after receiving it, I was in a continual state of nervous excitement. Fears that the School would begin without my receiving further notification of it, of a thousand different things, possessed me; but I occupied the time as fully and as profitably as I was able, and gave old bachelor tea and coffee parties, in my room, daily and nightly, to all my old chums and their friends, as often as they came to call upon me, in prospect of a speedy departure. It was not until nearly a month's time had elapsed, that I heard again from Penikese; but, when I did, it was in the shape of a final circular

which gave all necessary information relating to the subject. It read as follows:

"ANDERSON SCHOOL OF NATURAL HISTORY.

"Cambridge, Mass., June 26, 1873.

"M.....

"I have at last decided to open the Anderson School of Natural History, on Penikese Island, at 12 o'clock, on the 8th of July next. The place is fourteen miles distant from New Bedford, Mass., and the city is easily accessible by railroad from Boston or from Providence, R. I. Persons coming to join the School from a distance would do well to arrange their journey so that they may reach New Bedford Monday evening, the 7th of July. This place affords good accommodations at the Parker House, where information concerning the boat to the island may be had. A few miles to the east of New Bedford is a watering place, Mattapoisett, where those reaching this vicinity a few days in advance may pass some time pleasantly.

"It is necessary that all should remember that Penikese Island affords no accommodation for strangers, and that therefore nobody can be invited to visit the Island during the session of the School. I have provided rooms and board for all, but made no allowance for supernumeraries. As it is, I am not yet able to say what the expenses will be. All the arrangements have been made upon the most economical plan. The dormitories have been built at the expense of the School, and no rent will be charged, beyond a percentage on the bedroom furniture. The board will be charged at cost. A caterer has been engaged who will provide for the table and keep the rooms in order, superintend the washing, etc., and the expense thus incurred will determine the charges.

"It has already been stated that the instruction will be free. Aquariums have been provided which will take the place of books; and cans and other nec-

essaries for the preservation of specimens will be ordered, and may be bought at cost. The preparation for these collections will not lead to any considerable expenditure, and is optional.

"Very truly yours.

"L. AGASSIZ.

"P. S.—Should you be prevented from coming, give me early notice as there are many waiting for a vacancy."

I regret, very much, that I am unable to discover among my papers the circular containing the course of instruction, and the names of the instructors, as laid out for this *first* year of the Penikese Island School. It would be both valuable and interesting. I prefer giving such papers *entire*, when possible; but as in this case it is impossible, I will describe to you briefly our course.

The programme for Penikese (or "Pune," as it is sometimes called) hardly differed from that which had been previously prepared for the Nantucket School. The former certainly possessed many advantages over the latter,—yet the main purpose and aim of the "course" remained unchanged.

Throughout the Summer we had daily lectures from Professor Agassiz—upon Natural History, and upon Geology; and his talks on the glaciers and the glacial theory, of which he may now justly be called the father, were full and very interesting.

Then a generous citizen of Boston donated to the School a fine yacht, for sailing and for dredging purposes,—and the "Sprite," under the direction of that able Naturalist and seaman, Count Pourtales, carried dredging parties almost daily, or as often as the weather would allow, throughout the season. What material was thus presented for study! What splendid collections we made! How hard we worked to please Professor Agassiz!

Our lectures, the more important ones at least, were given in the early morning and in the latter part of the day.

Our dredging was carried on between times, so that, during the heat of the day, we were upon the water. Upon our return, Professor Packard would tell us about the crustaceous animals and the insects that we had captured; Professor Morse would take up the subject of the shells and molluscous animals procured; were there specimens to be examined through the microscope, Professor Bicknell's time was occupied, day and night. Then Professor Jordan described to us marine algology; Guyot, physical geography; Brewer, ornithology and oology; Hawkins, extinct mammalians; and Mr. Roetter taught us to draw them all. Then a dozen other gentlemen talked to us upon a dozen other subjects, so that our note books and our heads, I might well say our hearts too, were full ! full ! full of animals and the animal kingdom and Professor Agassiz, who knew all that there was to know about them both. Well do we now look back upon Penikese as the leading scientific school ever, before or since, in existence. Many believe that it will *never* be excelled in its character, or in the ability of its corps of instructors. This may be going far,—yet it is as certain that its stimulus and influence will be felt in scientific education for years, it may be for centuries to come.

Professor Agassiz had expressed the wish, that the school at Penikese should be "associated with the Museum of Comparative Zoology in such a way as to share at once and forever in any advantages to be derived from an institution so kindred in its objects and aims." He thought, and perhaps very wisely and truly, that "the two establishments," could "work together to the greatest advantage of both." The latter institution is today a monument alive to fame,—the fame of *one* man. A man whose chief aim and accomplishment was *to work and to teach others to work.* In his instruction he says: "I must make hard work a condition of a continued connection with the school." The *nature* of this "hard work" was "to prepare those who shall attend to observe for

themselves." More fully, it was, "to study nature." He says: "We should make *nature* our text-book;" and finally, disparaging text-books as generally mere compilations of useless and untrue materials, he asserts, again and again, that "we invariably return to the study of the things themselves, whenever we wish to make any real progress." Nobly did he practice his own teachings.

Athough the name of Agassiz will be handed down in history as the leader in scientific thought in the nineteenth century, it is yet certain that the Master of Penikese was neither afraid nor ashamed to acknowledge that to another was due the idea of establishing a school, after the manner in which his own classes were taught, but on a larger scale. In a letter to Mr. Anderson he says: "I have long cherished the thought of a summer school like the one proposed, and I have at various times in my life tried it with small classes, and for a few days or weeks at a time. The idea of establishing one at Nantucket, on a larger scale, was suggested by a young friend, Professor N. S. Shaler, who had a special taste for and no little experience in this kind of teaching;" but generosity was a failing with Professor Agassiz. He showed it again in relation to the *name* of the proposed school, when he wrote to Mr. Anderson: "As to its name, I hope you will allow the school to be named for you;" and, "my name it cannot bear with any propriety;" and still again, "To name it after you is, therefore, the simple and appropriate way of settling the question." Mr. Anderson, with equal generosity wrote: "I learn from Mr. Girod that you have expressed a wish to mark your appreciation of my gift of Penikese, for the purpose of the institution, by naming the latter after me. I feel necessarily deeply flattered by this offer, and can only say in reference to it that I leave that part of the question entirely in your hands, simply suggesting whether an institution, the initiation of which has been wholly the result of your own industry, and which must depend

for success mainly on your own labors, should not more aptly receive its designation from a name which has become almost a household word wherever science is known and appreciated,—that of Louis Agassiz." Thus in a contest of generosity will two names be handed to posterity.

Let me here say a few words, and a few words only, of the donor of Penikese Island: Mr. John Anderson of New York, who generously gave the island for the school, and seconded his gift by a donation of fifty thousand dollars ($50,000) for its erection and maintenance. This school, it will be remembered, has been styled both "The *Agassiz* School of Natural History at Penikese" and "The *Anderson* School of Natural History at Penikese." The former, from its founder; and the latter, from its donor; but there seems to me no necessity for either injustice or confusion in the matter, whichever of these titles are made use of, provided it be borne in mind that the *Anderson* School was simply a financial and substantial realization, upon a larger scale, of the *Agassiz* School of Nautucket. In the winter previous to the opening of Penikese the *Agassiz* School had been conceived, arranged for, and advertised, from the Museum of Comparative Zoology, at Cambridge, Mass., (December, 14 1872) as a "Course of Instruction in Natural History to be delivered by the seaside, *in Nantucket*, during the Summer Months, chiefly designed for Teachers who propose to introduce the Study into their Schools, and for Students preparing to become Teachers." No fair minded person will, then, for an instant, regard it as an injustice to either of the noble men to recognize the school by either or both of these titles; for it comprised both. I regard Mr. Anderson's motive in making the whole donation as purely and wholly philanthropic. A simple, short paragraph, clipped some years later, from a newspaper, whose date even is unknown to me, reads: "Mr. John Anderson, the founder of the Agassiz College, at Penikese Island, died at Paris, France,

on Thursday, aged 69 years." Alas that, as I write, Anderson, Agassiz, and Penikese, exist save as a memory—yet, as such, they will last, with *me* at least, *forever* and again *forever*!

As in the establishment of Penikese was recognized a new departure in scientific education, to provide for its future, and that the public might at once fully understand its proposed scope, Professor Agassiz advertised:

"The applications for admission to the ANDERSON SCHOOL OF NATURAL HISTORY are so numerous that it has been decided that the successful pupils of a preceeding year should have the first claim to admission the following season; next, the principals and professors of colleges and of high and normal schools; next, teachers in other public institutions; and, finally, teachers in private schools. Beginners cannot be admitted until after the applications of these several classes of pupils have been met. You are therefore requested to send me your claims to admission, before an answer to your application can be given.

Respectfully Yours,

L. AGASSIZ."

But a second year with Professor Agassiz was a happiness too great for mortal realization, so he was taken from us—"not lost, but gone before;" we can only follow in his footsteps and search after him. We will follow Nature to her beginning,—but we will find him again. The same patient, loving father, friend, and brother, shall again clasp our hand and direct our steps from Nature to Nature's God.

The second year, and the last, of Penikese, was conducted by Professor Alexander Agassiz, Professor Agassiz's son who, after the death of his father, assumed the responsibilities which the latter had left. This term was conducted on very nearly the same principle as the first had been. The "course" remained unchanged, in the main, and nearly all the old instructors and pupils returned. How hard we

all worked! It was a delightful summer! Had we never attended Penikese the previous year, it would have seemed perfect. But we mourned for our Master. We longed for his genial face and kindly voice. To *one*, at least, the second term of Penikese was but the skeleton remaining in the closet of the first term.

CHAPTER V.

Lectures: Morse, Putnam, Packard.

We are now at length settled quietly to work for the summer at Penikese. The bustle and excitement and arrangement in detail of the work of the first few days of our season are over, and we cheerfully "bend to the oar,"—of routine which is *not* routine, and of hard work which is truly a pleasure. Our time is all occupied: When we are not attending lectures, or out dredging, or otherwise collecting specimens, we are in our laboratories *dissecting* specimens, using our microscopes, observing the animals and plants which we have collected, and which are lying around everywhere in pails and pans of water, or in copying out our lectures. Our table is covered with knives, scissors, forceps, hooks for holding back the surrounding membranes from those upon which we are at work, and various other utensils. There are bottles of alcohol, sea-water, glycerine, and other preserving fluids—some with specimens in them and some without; there a large tin tray, about eighteen inches long and a dozen wide, half full of alcohol and water, in which are the remains of a skate-fish with the brains exposed, which we are dissecting with a view to showing the five pairs of nerves aud their surroundings exactly as they exist in nature, and with the outer membranes and flesh held back by pins, which are inserted into the wax in the bottom of the tray; and several birds, which had recently been shot,

were lying upon the table ready to be skinned and mounted or dissected and bottled—as were our other anatomical specimens.

Then we go to our lecture room and take notes from our Professors as they talk to us. Well do I remember how hard Professor Morse labored to impart to us some knowledge of the Molluscous kingdom, or the so-called shell-fish. He told us of their position in the animal kingdom, of how they were grouped among themselves, of the internal structure of each group, andof the life histories of many of the individual species. Under his direction, we dissected many of the larger sea molluscs, which we captured in our nets and on the beach at low tide,—and found it a most pleasing occupation, to follow out the various systems which they exhibited, and to compare them with those in both the higher and lower groups.

I remember that one of his lectures was devoted to the Snails. In it he told us of this great group,—how that they were called by naturalists the *Pulmonata*—from the Latin *pulmo*, a lung; and *fero*, I bear—signifying; that which they in truth are, the *lung-bearing* mollusks. Then he explained to us the three great groups into which they were divided. How well I remember those terrible names—for I learned them by heart, so that I could repeat them and their meanings over and over again—the *Geophila*, from two Greek words which mean *earth* and *loving*, refering to their terrestrial habits; the *Limnophila*, also from two Greek words which mean *lake* or *pond* [fresh water] and *loving*, owing to the fact that while the former live on the land the latter prefer the shores and mud-flats of, and mud in, fresh water pools, ponds, and lakes; and the *Thalassophila*, or those which love or live in the Greek *thalassa* or the sea,—these being *marine*. His remarks were confined mostly to the first two groups, more especially to the land shails. He told us: how they lived under rocks, stones, boards, the trunks of fallen trees and beneath their bark, and even amongst the decayed leaves of

the ground; how they crawl from their places of concealment and sun themselves, on warm spring days; that there were no distinctions of sex amongst them—both genders being combined within each animal; and that a little after the early spring they begin to lay their eggs, in large numbers, bunched together, and sticking to each other by a mucilaginous substance that also held the bunches to the boards, stones, bark, or leaves under which they were laid; snails' eggs are opaque and white, being longer than broad.

Then we learned that, if the weather were not too damp, the young animals, with complete, though at first small, shell, appeared in the gelatinous substance surrounding them, in a very few days after the eggs were laid,—though it generally took nearly a month for them to become fully hatched; that warm weather hastened the hatching process, though the eggs were seldom if ever laid in the snn; that the young hatched themselves, by eating the shell of the egg which inclosed them; that their growth was a rapid one; and that they fed upon vegetable food.

Here the Profeesor stopped to describe the teeth and tongue of snails, and to draw innumerable diagrams of these organs, representative of the different groups, families, and genera of this portion of the molluscous kingdom. In continuing, he said, that there were several species, however, which preferred animal food,—one variety even feeding upon the earth worms while another eat its own eggs. At about the first frost snails hibernate, or in some snug retreat, like that in which it has lived during the summer, goes into regular "winter quarters;" it retires further and further within its shell, forming mucous membrane after mucous membrane as it goes, until there are five to eight or more perhaps;—the functions of the body move slower and slower, until they at length wholly cease; and that American species, as a rule, are less gregarious than those of other regions. Some species, he said, had no shell or other hard cov-

ering whatever, and were then called *slugs*; that these were nocturnal in their habits, and committed extensive injury to gardens, which they are fond of inhabiting; that *slugs* do *not* hibernate, though they become torpid.

This, however, formed but a small portion of a single lecture: yet is there not here, even, abundance of food for thought and incentive to search still further into the mysteries of Nature?

Professor Morse is, evidently, an ardent evolutionist; yet in spite of his natural inclination to protract his lectures into some abstruse features of evolution, or of Darwinianism, there is always much valuable information in them that is carefully noted and remembered by every person present. Sometimes he tells us about that most wonderfully curious appendage of the bivalves or lamellibranchs, the crystalline style, and of how it has no attachment to the body,—this leads to an investigation, and our discoveries are marvelous.

One of his talks is devoted to *pearls*, and we learn that pearls are formed by the retention by the mantle of foreign particles, the irritation of which causes a pouring out of the secretions of its body substances—*thus pearls grow.* But while we are jotting this down, we hear the equally surprising fact that, though with the majority of shells both sexes are combined in the same animal, with the *Unios*, or fresh-water bivalve shells, the sexes are distinct and comprised in different individuals;—but he failed to tell us how generally, or in what special families, this bisexual arrangment exists throughout the molluscous kingdom—this, then, would be a capital point for investigation for some enthusiastic naturalist or specialist in this department, for I do not believe that it has ever been fully or accurately determined.

At still another time we learn that the shell itself does not obtain its color from the color of the food which the animal eats, as many formerly supposed. Of many samples given, the Professor laid particular

emphasis upon that of the *munera*, which eat green food and yet had a red shell. It is with such information as has been given above that we fill our note books and our heads,—we cannot take down all that he tells us, much as we would like to do so; there might be a few favored individuals present to whom the mysteries of shorthand or takegraphy would reward their possessors with all the words and ideas of our Professor; but *we*, an editorial we, applying to nearly everyone of us in the room, are not so far advanced in this peculiar branch of education but that our notes embrace but a small part of the hour's discourse, no matter how diligently we may struggle with pen and pencil and abbreviated English. You will doubtless smile as you read a page of my original notes—corrected simply as to its language:

"There is no muscular movement in the opening of the valves of a bivalve shell, but simply in its closing; in the one case the ligaments, contracting, push the shell open, in the other it pulls it from the inside. Lines of growth upon a shell indicate its age. The muscles of the margin of a bivalve shell are to enable the animal to draw in its mantle. To preserve molluscs, first kill the animals by immersing salt-water species in fresh water and *vice versa*, and then place in alcohol. In dissecting such animals, dissect under water, or water in which a small quantity only of alcohol has been put; if intervals occur during the work, replace the specimen in alcohol. What is ciliary motion? Ciliary motion ten foot square would exert a force equal to ten tons. It is ciliary motion that induces a current, and brings the food within reach of the palpi (or small *feelers*, as they are sometimes called), which act freely at a short distance only from the mouth; these *feelers* secure the food, mould it into pellets, and convey it to the mouth."

At this point, in one of our lectures, sometime yet before the close of the hour, one of the men brought in a huge skate fish and lay it upon our table. All

exercises were postponed, in perfect good nature, while Professor Putnam explained to us the difference between it and an immense sand-shark, over which one of the scholars was just then working. He told us, that the sharp tubercles of the skate were identical with the small, rough ones of the shark;that the skate was higher in its position in the class than the shark, as its embryo passes through the form of a shark before becoming an adult skate; that if one were to flatten a shark they would obtain the general appearance, in form, of the skate; a fish having spiracles, indicates that it lives near the bottom of the water; that neither the shark nor the skate possessed scales, and were, therefore, of a different order from that of the majority of fishes; and that the character and structure of the scales of fishes determined, to a large extent, the relative position not only of whole groups of fishes but even of many individuals in each group.

Later, in the same day, Professor Packard added largely to our stock of information. Many of us had sought to study up the subject of Animalculæ, in fact all of us were more or less interested in it; and forthwith, jars, bottles, and dishes of various sorts were filled with water, and large quantities of the very best material that could be obtained, for breeding and keeping them. Our hitherto rusty microscopes now fairly gleamed, in expectation of the marvels soon to be laid open, through them, to our wondering gaze. Professor Packard knew all about such things. He told us to "search in fresh water, rain water, water abounding in mosses, and marine pools, for our subjects of study and investigation." Somebody brought in to us specimens of worms and small parasitic crustaceans,—and of where and how to find others and how to preserve them, he told us: "You will find them in dissecting fishes and reptiles, in nearly every portion of the body and in the viscera; tape and sundry specimens of minute worms and flukes are found *in* the body. Place them at first in weak and then

transfer them to strong alcohol. A species of round worm inhabits the flesh and muscles of certain fishes. With the more common species of salt water worms, allow them first to die in fresh water, and then preserve like the others. One species floats upon the surface of the ocean, when it is calm. The best time to collect such specimens is from sunset to nine or ten o'clock at night," etc. But it is quite impossible to put upon paper all the notes which we collect for our note books; yet we hunt everywhere,—we fill bottles and jars, and our tables, shelves, and the floor, even, is filled with them: specimens, specimens, specimens, EVERYWHERE. Our professors lecture to us of nothing else; our time is spent in securing and dissecting them,—yet the more we learn the more there seems to be to learn about them.

LECTURES: AGASSIZ.

It is from such sketches of our lectures as those just given, that the reader will obtain a glimpse, faint and imperfect though it may be, of a single day's doings at Penikese. The *crumbs* that have been garnered thus for your benefit would form but a part, and a small part at that, of a single day's work. On an average, four lectures a day and often a fifth in the evening, besides laboratory and field work, form our regular daily task; then we write our notes out in the evening. Do you wonder where our time for rest comes in? We have none—our work is rest; and yet there is not one of us who does not enter into all this willingly. A certain President of Amherst College once asked the late Professor Charles U. Shepard, the well-known mineralogist, what he considered the "three most important elements of success to the young man during his college course." The Professor replied, without an instant's hesitation, "the *first* is work!" Then with a pause of several moments, he continued, "and the *second* is WORK!" and again

pausing, as if to impress his hearer with its importance, "and the *third*," here a much longer pause than any of the others even, "is WORK!" and he emphasized the word with all his power. Whether borrowed or not, the phrase contained then, as it does now, the *only* solution to the question. This is what we did at Penikese Island.

The lectures of Professor Agassiz are so individualized in character that they may very properly form a distinctive feature of this little sketch of our school. There are, no doubt, flaws in the matter, which is here presented as "notes" only,—but if such occur, they will doubtless be due more to the youth and inexperience of the pupil who took them down than to the possibility of mistake on the part of the lecturer; but, such as they are, we give them to the reader.

Professor Agassiz's first lecture was made up of somewhat disconnected suggestions as to the manner in which we should go to work to study the material to be found at hand, about and around us, upon the island. He said:—

"I would call your attention first to the soil and geological formation of our island. Points of compass are a very essential feature in geological formation. We find that the *barracks* lie nearly east and west. You will then find that the islands are cut into by numerous bays, necks of land, etc., and the question arises how are these formed? Then you must find out all about the rocks, their connection with the island and their connection with each other: the difference in the material beyond the rocks and beneath them; the difference of soil; and then how the whole resemble those of the adjoining islands. Find if there be any evidence of these islands ever having been connected. In our investigations we must deal with facts of Nature—this teaches us always to submit to truth.

"Now let us turn our attention to the jelly fishes, barnacles, fishes, etc., which will form our chief study

here. Do not handle *any* specimen more than is absolutely necessary, you never know to what extent you have injured it. Put your jelly fishes into pails of water by floating them from the net to the pail. A word more about our rocks: each one must collect specimens for himself. There will be found, probably, upon our island, three-fourths or even nine-tenths of all kinds of rocks in the United States."

At another time he again took up the subject and said:—

"Most all of the rocks upon our island are imbedded rocks, not rocks in place. Some of the neighboring islands show rocks in place. Our first question, upon seeing them is, Where did they come from? The mineral foundation of our earth is alike everywhere. This was first shown by Humboldt. When you find a rock *not* in position, hunt for one of the same kind *in* position,—then search for specimens between the two localities, and, if possible, trace their connection. Loose materials are called *erratic*, or boulders, etc.; the whole bulk is called *drift*; ledges and the like are called *rocks in place*. Our island probably contains specimens of all of our rocks, excepting those of volcanic origin. Your specimens should all be broken afresh, upon all sides, so that they may be more accurately studied. Rocks found near the water are usually assorted (those of a size being together), the larger ones lying higher up than the small ones. On hills and away from the agency of water, they are mixed; the small and the great lying together. By this means we recognize the two agencies that are at work depositing them."

The third lecture was devoted chiefly to hints upon how to study the jelly fishes, and was illustrated by numerous diagrams. Toward the end he digressed from his subject to give us a few remarks upon fishes,—especially regarding the *Scup*, a specimen of which, recently taken, someone had brought to him.

Of it he said: "The Scup is not found north of Cape Cod, neither is it found extensively in Southern waters. The American coast does not furnish many species of this family, though they are common in the Mediterrean and are called *Sparoids.*" He then gave us the names of the fins and facial bones of fishes. Professor Agassiz was always careful as to the books which he recommended for our perusal. Upon the jelly fishes he noticed but two: Allman's "Monograph of English Jelly Fishes," and Edward Forbes' "Medusæ."

We come now to perhaps the most interesting portion of Professor Agassiz's lectures, and those which embody his own original and personal work. They are given in as nearly the exact phraseology as it was possible to obtain them, and commenced some what as follows:—

"Nothing is more difficult than to present a subject whose evidence is incomplete. Regarding the aqueous or other origin of our island, its geological formation does not present sufficient evidence for us to form an opinion as to that origin that is capable of being sustained. There are, at the present day, many false views of great scientific questions held for want of sufficient evidence to assert the truth. One fact is but a small part of the whole evidence. A great deal of our knowledge, even at the present day, is traced back to Aristotle. The sources of true knowledge are very few. Christianity has, in a measure, prevented the advance of science. It has made us believe, and many are satisfied with that. Science, generally, hates beliefs.

"In 1836 I first felt an interest in these things. I began to investigate everything. I was at the foot of the Alps, when I found that the shepherds had a theory that the masses of rock, everywhere to be seen about them, had been brought down to their present position by what were then known as *glaciers.* An eminent civil-engineer, who was then present, held the same

view. Hitherto, the theories respecting the geological formation of the earth, as held by Werner, were that all this material had been brought together by water and flood; the Scottish school of scientists maintained that it had all been accomplished by volcanic action. A violent feud ensued. Leopold Von Buch asserted that both were right. He gave to geology its present shape. I was then a student. Being at the foot of the Jura, I saw rocks in places where it was impossible for water to carry them. The thought came to me that glaciers transported rocks in Switzerland, and why not here also? I thought: why might not glaciers occur in other countries than Switzerland? I went to other countries and studied the evidence. I found that the rocks which glaciers moved were polished, or rough and scratched. Water rocks were hollowed in soft spots, thus making prominent the hard places. Ice produces a smooth surface. Pebbles worn by water are smooth like a hammered surface—but dull, not shiny; ice polishes the surfaces and scratches them. If the ice goes in one direction all the creases will run in one direction. Loose pebbles scratched by ice and by water are also different. Erratic boulders are always found in connection with loose materials which are scratched and polished. Loose materials are not stratified. I found out these facts in my study in Germany, France, and in other countries. I went to England, and there found evidence of this glacial action. I was with a friend—Mr. Buckland—and we were at first alone in our theory.

"The conclusion we reached was, that at one time the globe was much colder than it is at present. In science one should never suggest anything for which there is not some foundation. The glacial period must have been posterior to the geological period when mastodons and elephants inhabited the whole globe and the climate was more tropical than it is now. We estimated that ice was once 10,000 to 12,000 feet deep all over the globe. It is chiefly in

temperature that changes occur. If ever our island (Penikese) was below the sea, why not find the same rolled pebbles and low-tide marine animals? No sea has been beating here, for we find no sand or loam has been washed away. All the loose materials remain *in place*. The greater part of the local peculiarities, such as depressions and inequalities, will have been produced by rain. Glacial action *will* explain the peculiarities we see on land here. There is nothing so hard to protect as a man's intellect. We can get no patents on our investigations."

The same subject follows in his next, or fifth lecture:—

"A geological period or age ago, the surface of the earth was covered with boulders; this was before there were either plants or animals to be found upon it. Now to understand and to translate the transportation of glacial rocks we must understand the formation of glaciers. The idea of glacial motion originated with the peasants of Switzerland. A civil engineer, Werner by name, and a peasant, Charpentier, however, got much of the credit for field observation which I had myself done. In 1837 no geologist admitted that rocks were moved by glaciers; most of them admit it now, though in a somewhat modified condition. The early scientists who were interested in and studied into this subject, were Scheuchzer, who also first described several fossil fishes; Horace Benedict de Saussure, who published his travels in the Alps, and who first described glaciers; Charpentier, who studied them considerably and published articles upon them; and myself, Professor Forbes, and Mr. Tyndall, who, lately, described their physical constitution, action, etc. Of these Mr. Tyndall's work is the best. We now come to the question, What is a glacier?

"Glaciers are composed of different materials according to the positions selected for investigation. On mountain tops they are mere snow fields; deeper,

they are composed of ice crystals, the ice becoming more and more compact as you go downwards; until the bottom is clear, solid ice. Snow when resolved into fine granules is called *neve*: where this changes to ice is called 'the limit of perpetual snow.' Physical geographies are incorrect in their statements of the snow-level on the Straits of Magellan and many other places. Similar conditions are found at the same line of perpetual snow; they are also similar in the same number of degrees distant in different localities. Glacial ice differs from common ice,—the first is composed of ice crystals melted together and can be reduced to powder, the latter is formed in layers. Glaciers possess a motion in themselves which is both an upward and a downward motion; it is greatest in the middle, and least upon the edges. Moving ice, therefore, exerts a great power. As the glacier moves, it collects a large quantity of loose materials which it carries along with it. Part of this material over-crowds itself and forms a low line of rocks on either side of the glacier: these lines are called lateral moraines. When two glaciers or two arms of the same glacier unite, they continue as one, while their lateral moraines unite and form a medial moraine. The bottoms of glaciers, then, being covered with rocks, act like an immense rasp. In passing over walls of rocks, or open faces of exposed ledges, both the upper faces of the under rocks, and the under faces of the upper rocks, which are in the glacier, are scratched and scarred alike. Yet the rocks which are *in the glacier* will still be angular above where only the ice covers them. Now the continual motion of the ice pushes forward the larger rocks, and at the same time all the loose material is ground still finer; and each pebble rounded in a manner which is never produced by water. Thus the moraines are ground more and more as they advance, so that, whatever their shape may at first be they come out, at the end of the glacier, rounded material; and when the glacier begins to

melt and to recede they are deposited as single or successive *terminal* moraines. These are crescent-shaped ridges or walls of rock and loose material. If small glaciers will accomplish so much, what might not large ones do?"

In his sixth and seventh lectures he still continues:—

"When a glacier meets with an obstacle it breaks and forms crevices. You will find no crevices in *neve.* The more compact the ice the deeper and broader these are. In a hot day the sides of the glaciers melt and form small brooks. These are sometimes too wide to cross. They carry with them an immense amount of rubbish, which fills up many of the cavities and gaps, and makes pot-holes and new excavations. Sometimes one of these brooks will traverse the whole length of a glacier.

"The geological phenomena connected with glacial action are extraordinary. There are boulders upon the Jura which, in mineral character, have been traced to the Alps; and at the foot of the Alps is a pudding-stone which is found in the Jura. There is no doubt as to where it came from. Professor Guyot has done more than any other man in studying erratic phenomena. He has proved, that what is in reality done between the Alps and the Jura has been done by glaciers and not by water sweeping up the plains. Water would leave transverse ridges of rocks, while those which occur are in longitudinal ridges, and must have been caused by glaciers from the Alps. How, then, while Switzerland was so cold could England and other countries have been so warm. *I* think that the whole globe was covered with ice. I have found traces of glacial action everywhere in mountainous districts that I have searched. In the White Mountains, north of Franconia mountains, is a ridge of thirteen plain morraines. They occur on all sides of the mountains, also. There are signs in New York, Ohio, Maine, New Hampshire, Massachusetts, as far as British America, and still other

places. Everywhere is evidence of a great glacial sheet, of immense thickness, passing over mountains five and six thousand feet high, which left boulders of a similar nature upon their tops and each of their sides. I think that the ice in some places must have been at least fifteen thousand feet thick. It moved in a North-South direction. In Siberia, Asia, and in the United States, gigantic animals were found imbedded in the ice, in perfect preservation, and showing the contents of the stomach,—proving that they must have been overpowered suddenly,—perhaps by frost. I think that our large and small rivers are the result of the melting of these glaciers.

"Drift phenomena must be studied locally. There must have occurred local ice which distributed itself in plains different from that which came down from the mountains. The idea that the glacial period was simply an extension of the Arctic ice is nullified by the fact that at the southernmost limit of that ice sheet is a large moraine. The drift wanes in distinctness from north southward. This period, therefore, was not an enlargement of the northern glaciers. In America are intimations of local glaciers, but they are few; for example, in the White Mountains, on the coast of Maine, and especially at Mt. Desert. The characteristic of drift in America is that it extends over a plain evenly, and without indications of lateral moraines. The hills on the borders of Lake Superior are scarred over their whole surface, slope and summit. Indications that this action has been even from north southward is, that the south side of the rocks is not polished, but the boulders are rough and unmarked. In some places there are deviations of much less extent running from 20° to 30°, sometimes almost at right angles with the main line: these are indications of local glaciers—these often run northwest and southeast. Another peculiarity of American glaciers is that most of our boulders are rounded —those of Europe and Scotland are angular; where we have circumscribed glaciers we have rounded

boulders. We seldom find median moraines in America. The Arctic glaciers encroach largely upon the sea. Our continent has once extended into the sea in the shape of a drift. The level at which the drift extended over all these islands was the same. I think that these islands were once mainland. Local glaciers have been described in many localities, especially by Professor Dana; but they are the effect of a great northern drift and not from local causes, as might be implied."

Toward the last of the session he returned to the subject and gave us his final lecture upon this wonderful subject. He says:—

"Perhaps the most important feature of glacial action is found in the terminal moraine. It contains a mineralogical collection from all the region around, which comes from the upper regions and falls or is detached by the glaciers, and all pushed together toward this terminal point of the ice. To examine these moraines and trace the specimens found to their real or probable bed rock is a most important labor of the geologist. That glacial action was once carried on to an extent much greater than could have been possible had the period begun with an enlargement of the Arctic glacier seems evident. Thus we find copper identical with Lake Superior copper in Michigan, Indiana, and Iowa, and even as far as 500 miles south of its origin, having distinct marks of glacial agency upon it. The rate at which glaciers moved in America is not certain. In the Alps, where the slope adds to the inclination, the maximum motion per day is one foot; the minimum thirty inches per year. Let us assume that our glacier moved 100 feet a year,—and it will take fifty years for the boulder to go one mile or 25,000 years for it to reach its present position."

[It has often struck me as a curious fact that in estimating geological time Professor Agassiz (as well as others) appears to make no account of the fact that

were the motion of the glacier thirty inches a year the period would be forty times that amount or 1,000,000 years; if, on the other hand, the motion were faster, the time would decrease in proportion. The rate of time necessary to accomplish a given object may not always correspond with the *numerical calculations* of writers. Experiments in the chemical laboratory are sufficiently numerous to show the different actions of the same substance under different conditions, say some substances precipitate in 10 minutes with sufficient heat that might otherwise remain 10 or 10,000 years *without* that heat, and to make us pretty careful as to how we lay down a law upon insufficient evidence. Hence, our given geological time *must* be more or less hypothetical under *any* circumstances.—ED]

"Large animals being found imbedded in the ice are evidence of its coming quickly. It is not likely that a snow storm capable of freezing large animals in Siberia and North America would be limited to one particular region. It would be graded according to latitude. The question is, how much was there in the coldest latitude; how much in the warmest? Let no one fail to urge upon the members of any expedition to the Arctic regions the importance of ascertaining the motion of Arctic icebergs and glaciers. This motion can be ascertained by the amount of icebergs which float away from their extreme southern limit."

It is thus that we learn the first principles of glacial action. How careful our instructor is to distinguish *facts* as truths; and *possibilities*, only, he weaves into theories, which he is very careful to impress upon us *are* possibilities. In a letter made public some years since, he said: "The office of Science is not to record possibilities, but to ascertain what Nature does," again—as far as one "deals with mere arguments of possibilities or even probabilities, without a basis of fact," he says, that one "departs from the true scientific method." These words are as true

today as they were the day they were uttered; they will be as true a thousand, yes, ten thousand years hence: Living truths that never die.

Professor Agassiz lectured to us every day, and sometimes two or three times a day. His suggestions to us in our study of the Animal Kingdom and upon embryology were also of the greatest interest and importance. At one time he tells us:—

"We begin, today a course of lectures on the Animal Kingdom. To know how the knowledge was obtained we must study the history of Zoology. There was a time when animals were studied by their external features alone, and scientists knew so little about classification that they arranged their information alphabetically. One of the earliest scientists to which we refer today was Caspar Gessner (this should doubtless have been Conrad Gesner, though it is Caspar Gessner plainly in the notes taken at the time the lecture was given). The first classification of animals was into aquatic, aerial, and land animals. Aristotle was one of our earliest and best scientists. Linnæus' *Systema Natura* is a marvelous work, considered from our greater and his lesser knowledge of the subject of which he treats. The period of Cuvier is as remarkable as that of Linnæus. He introduced anatomy as the basis of classification, (there were three editors of his *Regne Animalia*, in 1817, 1829, and in 1834). Contemporary with him was Carl Ernest von Baer. He studied embryology and arrived at the same conclusions. He gave to the Animal Kingdom four classes. Dollinger was the founder of embryology. He was great as a guide to further labors, —Baer was his pupil. Sanders' *Embryology of the Chick* is an important work for students in embryology. Ostroeicher's studies on the capillaries were written under Dollinger's directions. Oken wrote from suggestions made by Goethe. The elder Carus and Geoffrey St. Hillaire works contained the studies of homologies,—the latter is now a most important work for the continued advancement of Zoology.

Will someone explain the difference between analogy and homology? Of embryology as a study in itself Professor Agassiz said: "It is a wonder that such broad and comprehensive generalizations could have been made upon a basis of knowledge derived from so few animals."

Again, he takes up embryology and says:—

"The eggs of birds were known, and their parts named, very early; these have been transferred to all other eggs. We have the yolk, with its vitelline membrane; the white; the shell with its two lining membranes with the air space between them at the larger end; and the suspensory cords. Of all these the yolk alone is necessary in producing the young,—in fact, the others may *all* be wanting. Eggs can be of any form. The yolk is a fluid, organized, and at first appears albuminous. The *blastoderm*, or life portion, is surrounded by a congregation of light cells which cause it to always appear on the top—no matter how the egg may be placed. Baer discovered the mammalism egg, and about the same time, 1837, the cell doctrine was advanced. Through the influence of Schleiden the structure of animals and plants began to be compared. Studies of cells and the cellular structure has been continued ever since. They described the cell membrane, the *nucleus* or point of special life, and the *nucleolus* or point within this point. Microscopists sought cell tissue everywhere. Embryologists sought the smallest eggs. All parties agreed, finally, that eggs were cells destined to an enlarged growth—a peculiar development and, ultimately, an individual existence.

"Forty years ago the theme of science was the function of organs: Today, it is cells. The minute tentacle of the hydroid polyp contains, at once, cells —nervous, muscular, and assimulative. Thus all structures are formed of differentiated or specialized cells; all parts of animals are formed of cells. The study of the changes undergone by these cells has only just begun. Until we know how new individ-

uals originate we cannot speculate upon the origin of species. With a power of 1100 diameters we see, in these minute eggs, small dark spots in the stroma. We know nothing of the properties of these bodies. All we can tell is that dots of all sizes may be seen, hence we conclude that the dots grow. In the larger dots we notice a difference between the periphery and the center, the latter being less dense. Next we see a central condensation. Later a mere hollow until we get a perfect nucleus. Finally, one or several germinal dots,—and we have the so-called ovarian egg of the embryologists with which they begin their investigations."

Well do I remember how often Professor Agassiz urged us to "read only the best books." He seemed especially fond of Cuvier's works, and time and again impressed it upon us that they were a "most valuable basis for scientific study." Among his odd table-talks—for he often talked to us from the breakfast, the dinner, and thetea table—and even many other times, in the laboratory, and anywhere where that he could find an object to talk about and a group, of two or three, even, to talk to. "Be sure" he would say, "to examine all protozoa which you may secure, to see whether they are independent individuals or different stages of the same individual." In urging a study of Physical Geography, he would add, "for a knowledge of Physical Geography is indispensible to any student of Natural History." He heartily indorsed Professor Guyot's works upon that subject. There were few books he *did* recommend to us, for he cordially detested the ordinary books upon scientific subjects. At one time, in a paroxysm of rage at these "would-be scientists," he exclaimed: "they are mere compilations of persons unfamiliar with science, who mix the false and the true:" Alas, shall we ever again meet with his equal, as teacher and pupil and brother combined!

To one unacquainted with Professor Agassiz, the scenes at Penikese, during the second term of her

school, was full of fascination and lively animation: but to us, who had studied under the Master, it was one with "the whole head sick, and the whole heart faint."

In presenting the history of this *second* and *last* year of Penikese Island, if I have followed my diary somewhat closely, and thus of necessity repeated many things that had already been said in any previous chapter, I hope that they will not appear objectionable on such account—since they may introduce us to new features of the original plan, and lead us to new pleasures in the inexhaustable field of research.

CHAPTER VII.

Second Year at Penikese; Laboratory Work, More Lectures, Familiar Daily Scenes, Recollections of Agassiz, Theodore Lyman on Fish Culture.

Just one week upon the island, and though we have had plenty to do the time has passed quickly and pleasantly enough. There are, of course, a variety of employments, and no one is confined exclusively to any one thing all the time. You will see some in the laboratory busily employed in the dissection of fishes or other animals. They carefully trace, from origin to terminus, each organ—however minute—and accurately determine its relation to the other organs and to the surrounding parts of the animals. Then the nerve systems are followed through their various courses to their seat, the brain, which is laid open and shown in all its perfectness. Finally, the veinous and arterial blood systems, injected (to show their finer terminal portions) or not, followed with slowness and with the utmost precision, teach the student lessons which they can never forget. On shelves, in our laboratory, will be found carefully selected and prepared specimens of these dissections, and the digestive organs of various species, all neatly tied and suspended in alcohol. Only one week upon the island yet we have laid out work enough for a year's hard labor already,—but we came here to work!

Others you will find at work upon some minute, and often microscopic, dissections of the common clam or mussel. Here our injections do a most beautiful work. Different coloring materials are mixed with gelatine, and, while yet warm and in a

liquid state, are introduced into every vein and artery, while every fibre responds; then the whole cools with a hard, fast color.

Still others are busy over beautiful sea mosses, and the minute and delicate polyzoa and protozoa with which they abound. Professor Bicknell has a class in microscopy, and Mr. Alexander Agassiz will, as soon as his health permits, give instruction about sea animals, such as the medusæ, starfishes, sea urchins, jelly fishes, etc., and also in embryology.

The aquariums are not all as yet in full running order,—though many of them are already well-filled with sand, stones, sea-weeds, and a goodly number of specimens that are especially adapted to live and thrive in such confined quarters, and represent quite fairly the animal life of the surrounding waters.

One of our students has recently secured and placed in his tank, one of those most beautiful, delicate, and altogether wonderful little animals, so rare upon our coast, the *Physalia*—often called the Portugese Man-of-War, or the *Physalia arethusa* of the scientist. It is an exquisite little beauty—a dainty, fragile gem—and belongs to the class of *Acalephæ* or Jelly Fishes, of the order *Hydroidea* or Hydroids, which are also known by the name of *polyps*, from two Greek words signifying "*many-footed*", referring to the *tentacles*; which were, doubtless, in olden times supposed to be feet,—and, apparently, not without reason, since *tentacle* is from a Latin word signifying "a feeler,"—and many of these lowest forms of animal life have no feet but their feelers which must thus have originally been supposed to be feet, both from their shape and from their appearance. One little animal, therefore, has quite a history of its own. Of late years, scientists, who delight in changes and lengthy names, have classed it as: Branch III (of the animal kingdon), *Cœlenterata;* Class I, *Hydrozoa;* Order III, *Siphonophora;* Genus, *Physalia;* Species, *Arethusa.* Now these long names are apparently meaningless to the majority of mankind, but as we have no specimen

before us, let us try, through the medium of the "*dead* languages," a little induction *a posteriori*, and discover, if we can, *what* our specimen is really like. So we procure the Greek and Latin lexicons, and begin our work. With a little difficulty, we find that our first hard name, *cœlenterata*, is derived from two Greek words, (*koilos* and *enteron*) signifying "hollow-entrailed;" this then lets us into the characteristics of the animals of the branch—that is, their internal organs are, in a great measure almost wholly wanting, or, if present, of so simple a nature as to perform the functions of digestion by means of a bag-like stomach which digests principally by assimilation. Our next word, *hydrozoa*, is quickly found; the "*hydra*" or famous many-headed monster, or serpent slain by Herclues, standing for the first part of the word; and "*zoon*" (or zoön as it is often written), the Greek word for an animal—this gives us the key to our class characteristics. The third word, *siphonophora*, is still more plain, being derived from almost identical Greek words signifying a "tube" or "siphon," and "I bear" or "bearing." The word *physalia* comes from a Greek word, also very similar, which signifies "a bubble." *Arethusa* was the name of a beautiful nymph of Diana's: she was afterward changed into a fountain.

At first sight, the Portugese Man-of-War would put one in mind, as the name suggests, of an immense oblong, somewhat egg-shaped, bubble of air, with a crest of wavey, wrinkled crenules, much thicker than the surrounding parts, spanning its top and extending to its attenuated ends; the whole an iridescent or burnished purple, with reflections of an hundred kindred colors. But, while this delicately shaped and gorgeously tinted little animal rides gracefully along upon the top of the water, dancing merrily with its ripples, we suddenly become aware of an hitherto unseen dense bunch of what resembles a mass of seaweed, of fine, crinkled hairs and threads, some of which extend far down into the water. We examine

it closely—perhaps touch it with our hands. It stings us with an electric stroke that makes us feel as if our whole hand had become suddenly alive with a fiery infusion of nettle, which remains for nearly half an hour. The bubble itself, to this wonderful, composite animal, is four to six inches in length and some three wide and high in its centre. The bunch of living polyps beneath, twice that size; while the ravellings, for such they seem to be, hang downwards to from twelve to eighteen inches below the clustered mass above, Now this assemblage of living individuals must be studied separately from the bubble, as we will still call it. Investigation proves that this is not a single individual, as would at first appear, but a colony of innumerable zoöids, carrying above them, a huge wind bladder—apparently, only to sustain them just below the surface of the water. The true home of this living, floating island is in the Gulf of Mexico. It must, therefore, only casually drift so far north as its present limit—which is rarely beyond Cape Cod. Three specimens, only, were found during our stay at Penikese, of which, I believe, I alone was the fortunate possessor of the only live one. It was found stranded upon the beach, one morning after a severe storm, in a nearly perished condition. How it survived the storm, the rocks and sand of the beach, and the amount of handling which it underwent in being transferred to a pail or fresh sea water, thence to my aquarium, I cannot well understand; yet it lived, and threw off a whole tank full of young, which went paddling around everywhere, of their own free will, "as happy as clams at high water."

This is only one of the many things which occupy our attention. Nearly every aquarium presents something of interest to study, and every moment of our time is fully occupied. Among the animals in some of the other aquariums are: both species of our common stickleback, the sea mullet, several kinds of periwinkles, and both the large and the small hermit

crabs, which, as they peer cautiously out of their shells, or travel rapidly about with their curious side-long gait, resemble, somewhat, minute, full-grown lobsters—and amuse us all highly. There is some talk of setting up a small windmill, that the supply of water for our tanks may be regulated with some degree of certainty, as necessity requires that it should be. Our "finds" can then be all properly cared for, and fresh water constantly furnished for them, as is not now the case. Otherwise, we shall be obliged to continue bringing in the water in pails and letting it carefully into the tanks through rubber tubing, which is now provided for that purpose. Thus our general laboratory work, and plans for its furtherance, progress as well as one could possibly expect with the limited means at our command.

While the students study hard during the day time, they amuse themselves, in the evening, by strolling about the island, sitting upon the balconies and enjoying the delicious evening air and fresh, sea breezes, or rowing or sailing over the cool, restless waters round about the island. On Wednesday and Friday evenings Professor Meyer gives us delightful lectures upon *sound* and *hearing*,—illustrating his experiments with the excellent and costly instruments brought with him from the Stevens' Institute, Hoboken, New Jersey, from which place the genial professor himself hails. His lectures, though not compulsory, are attended by everybody, both old and young, and the lecturer is as great a favorite as what he tells us is interesting and instructive.

Occasionally we have lectures upon the lower forms of animal life, by a Professor Barnard—a rising young naturalist, who enters quite deeply into the subject. We have quite thorough descriptions of all the lower forms both of animals and vegetables,—but more especially the former: those whose structure is that of a simple, proto-plasmic mass, without any definite form, or without (at times, apparently,) even the little nucleus or life cell which is possessed by almost

every animal in existence. Lectures upon these subjects are of the highest importance to those engaged in microscopic work and study. One is often completely at a loss how to make the best use of the material at one's command, without a thorough knowledge of just these very minute organisms; and what a field for microscopic investigation they unfold.

Among the rare captures, which have been made during the week, mostly from the contents of the "pounds," several of which are located in various places in the water not far from our island, and out of which fishes and other marine animals are brought to the school several times each week, are quite a rare species of the skate fish, a specimen of the thrasher shark, and several other species of fishes interesting, especially, for dissection. The students have already made abundant alcoholic dissections of the common ground shark—a small animal of the shark family, about three and a half or four feet in length, which is a very great nuisance to the fisherman; of the common skate; and of the flounder or "flat fish," as we were wont to call it when we were boys. In these the various organs and systems have been traced out, and are shown in a most perfect and beautiful manner. The work in this department is going forward under the direction of Professor Putnam.

A few of our students are particularly interested in the minute dissection and study of animals of the molluscous order. These are guided by Professor Morse, who is assisted by Mr. Brooks, who evidently knows nearly as much about the subject as the professor himself, and whose beautiful preparations are the wonder of all who behold them.

A number of large diagrams have been prepared, with great skill and labor, for the use especially of beginners, illustrating the complete anatomy, as finely as it can well be rendered on paper, of the leading animals in each group of the animal kingdom; these have been hung about the walls of the laboratories in

the most artistic manner, and present quite an imposing effect as well as being very useful.

The latter part of this month Professor Packard is expected to arrive. He will give instruction in entomology and the crustacean and worm families, and take charge of the dredging expeditions. Some very interesting species in these departments appear to be quite abundant in our locality,—both on the shores of the island and in the deeper waters farther off, where they are being constantly brought up by the dredge. As many of these are microscopic, a most promising field will, without doubt, open to the investigators and investigatresses who shall enter therein.

Among the great days upon the island is *mail day.* This occurs whenever the steamer, or any other water conveyance, brings the mail bag: generally twice a week. One has but to say: *the mail has come!* and immediately everything is in commotion. Everybody stops work. No one can think of dissections, lectures, or drawings, at such a time. Professors and pupils, all, flock to the lecture-room, where the bag is opened and the letters and papers distributed. Newspapers are a much coveted article with us, though we none of us have any too much time to devote to them; and each paper goes the rounds of everyone on the island until it returns to its owner literally, as the school-boy said: "black, and white, and red," (read,) "all over."

Our work obliges us all to be early risers at Penikese, and I shall not soon forget the self-contented grin of delight with which Cuffy—our small, black, table-boy—armed with an immense tin horn, nearly or quite a foot in length, and such an one as would have delighted the heart of the most fastidious of college Sophomores, used to rush down the walk to the dormitories, and proceed to awaken the sleepers therein with the most resounding *toots* and heart-rending buzzing sounds that he could evoke, as a signal that breakfast would be ready in *about* half an hour. Well did he perform this his most delightful

duty! He would usually continue the exercise until the most obdurate lover of Somnus had become fully aroused. The flourishes and grimaces with which all this was accompanied and executed would have caused many a hearty laugh, could you have seen him, as you were awakened, in spite of your desire to remain longer in delicious repose, by the perseverance of the good-natured urchin, who reminded one greatly of a small, insignificant, but very troublesome fly, who returns again and again, as often as you drive him away, to torment you.

Our dormitories, this year, are much more convenient, in every way, than they were the year previous. Now there are plenty of rooms; and each person is thus provided with a separate and individual apartment. These two buildings, which are dormitories above and laboratories beneath, are crossed in the center by a lecture-room, and look, from without and at a little distance, like an immense letter H. The laboratory doors face the sea—at least two of them, at the rear of each room—and give us plenty of fresh air, as well as a fine view of the harbor and of the surrounding waters. In these rooms we are busy by day and by night. I recall one of our number who labored both diligently and often at the Echini. These "Sand-dollars," as they are vulgarly called, engrossed his especial attention. The seamen call them "Spanish dollars," owing, no doubt, to the fact that they come from the bottom of the sea and call to mind, perhaps, the old legends of hidden treasures restored to rash adventurers by some similar, seemingly mysterious process as that by which now we dredged old ocean's bottom, and brought to light its valuable products.

During our second week upon the island, which has just closed, we have had another delightful evening lecture on *sound*, by Professor Mayer; his agreeable manners and perfect experiments making it doubly interesting. Mr. Barnard, also, has given several additional talks upon the protozoa or lower

animals; but, although the speaker tried his utmost to illustrate the difference between these lowest forms, I sadly fear that, to many, the *amœba* and *protamœba* and *amixa* and *protamixa*, were so confounded in the minds of the listeners, owing, no doubt, to the slight real difference between them, that few appreciated the lecturer's earnest efforts. But Mr. Roetter, the genial, patient Mr. Roetter, has shown more and more of the calm endurance required to complete a finished, satisfactory sketch of some object of special interest. How slowly, methodically, and yet how well he drew and instructed; his own drawings were our object lessons, often,—and well we knew that we could never attain to such a degree of artistic beauty and excellence. It was thus that each professor, in his department, sought to give us his *best* from which to form a model for us for our future scientific advancement and career.

Sunday! It is a very quiet day with us: no work,—but complete rest. We have church, or rather a sort of social meeting or gathering together in the morning, and are left free to wander where we will for the remainder of the day, which closes with a *singing service*—if so we may call it—from the little fort on the hill, in the evening, and from which it is accounted quite a disgrace to be absent. In the singing all who can and wish join.

After considerable urging, our colored waiters form a chorus of their own and treat us to some of their native songs. Far over the waters float these simple words of praise. Everyone who has ever heard them is aware of the wonderfully peculiar pathos that there is in the melody of songs sung by good colored singers. There were four in our chorus, and their voices harmonized well together. We retired from the little fort, during the singing, and the minstrels occupied it alone. They sang with great power, pronouncing each word clearly and distinctly. Their songs were simple, both in word and in tune, but they seemed to us, upon that wave-lapped island, so far from land,

as coming from creatures more angelic than human—more divine than the civilized relics of a barbaric race. We remained near and listened—some standing, others reclining upon the grass near by: And so the twilight passed into evening shades, and they into the darkness of the night, and it was late before we retired.

Today, Monday, Professor Wilder gave us a lecture upon Professor Agassiz. He told us that the latter had told him, some time previous to his death, that he feared that he might pass away at any moment, and that he believed that his days on earth were numbered; that he might die, "in a year, a month, a week, a day, or even an hour," adding, simply, "and I am prepared." Such were Mr. Agassiz's own convictions. We too, believe, with another, that Professor Agassiz's death is "one of the deepest calamities that has fallen upon the thinking world."

But let me stop for a moment to tell you who Professor Wilder is. He seems more personally attached to Professor Agassiz's family than most of our other instructors. He is eager to execute Professor Agassiz's slightest wish, and is here and there and everywhere about the grounds. He lectured, also, upon many themes: the lancelet, sharks, rays and lampreys. He also began a course it NEUROLOGY. He had a deep reverence for truth. *Truth* in *Science* must be paramount. His enthusiasm, also, was equal to that of any of our teachers, and though still young he gave signs of that prominent activity of mind for which he afterwards became so noted.

On Tuesday evening the old Agassiz Natural History Club was again organized, with a president, two vice-presidents, a secretary and treasurer combined in the same office, and an executive committee of five members. The meeting was opened by a few remarks, appropriate to the occasion, by the president, and then given up to the discussion of scientific subjects, which pleasantly occupied the remainder of the evening. Remarks were made on the movements of

the eyes of fishes while swimming in different positions in the water. Two of our professors, who were present, explained: The one, the nerves and movements of the fish eye in general; the other, the general structure of the eye and the apparent reason for the peculiar movements previously alluded to. The question was, as to whether the pupil moved in a line with the inclination of the body or not; the opinion, pretty generally expressed, seemed in favor of the affirmative. Remarks were also made upon the difference in the development of the tadpole, or young, of our different species of toads and frogs. In showing the periods of growth in the different species, the speaker said: that in batrachians the hind feet were those which were first developed, while in the salamanders it was the fore feet; thus distinguishing the young of these two great classes. He said that all our species of the former, excepting those of the green and spotted frogs, assume their true form very soon after hatching from the egg, while those refered to were sometimes two to three years in maturing. He showed, also, that physical conditions have much to do with the quickness with which they assume their adult forms, and that they must be able, for their proper and perfect development, to leave the water at times, and climb up upon the mud or earth banks of their breeding-pool, where, thus keeping their bodies still moist and hence supple, they could, at the same time, exercise their limbs and receive the sun upon them. And thus, after many other interesting and instructive discussions, the meeting adjourned for one week.

Our lecture, about this time, from Professor Theodore Lyman, the veteran Fish-culturist, upon the subject of pisiculture, excited in us a great deal of attention. I well remember how masterly he handled his subject, and how we admired his instructive talk upon a question of which, hitherto, we had remained in such utter ignorance; and this, as near as I can re-

call from the few notes I was able to take at the time, is what he said:*

"Artificial fish-culture, means the culture of fishes artificially: the surrounding of them with *conditions* of growth which shall render their growth more favorable than as it is found occurring in Nature." We understand, by this, that the lecturer would seek to take away the deteriorating environments in Nature which seek continually to undermine and undo that which she seeks continually to do, by creating fish-breeding establishments whose object shall be to assist Nature in her best endeavors.

"The true fishes," continued the lecturer, "are egg-bearing animals which lay their eggs in the water. In the salmon and trout, the female works a hole in the ground with its nose and tail in which to deposit them. The shad lays its eggs differently: it comes from the sea up the rivers to spawn, as the process of laying the eggs is called, which occurrs free in the water. They are light colored, transparent, globular, and hatch in from twenty-four to forty-eight hours. The percoid fishes make holes or nests in the sand and, after the eggs are deposited in them, watch them with great care.

"In breeding fishes one must be careful about four things: raising the young from the egg; transporting live breeders; dams; and protection from surrounding enemies."

"The *Salmonidæ* include the salmon, trout, white-fish (of the great lakes), smelt, and capereing, as principal types; they are all good food fish but the last." I cannot believe that the lecturer was fully aware, however, of the extent to which the latter fish is an article of food (caught, dried, and preserved for win-

*Our object in quoting Dr. Lyman's lecture, is not so much to inform one upon Fish-culture,—though in this respect we hope that it will not be without its fruits,—as to show how little we knew then of a subject which, in so few years, has sprung up to be one of the most important subjects of the present day.

ter use) all along the coast of the north shore of the St. Lawrence, even along the Labrador peninsula, when he made the above remark. "True trout and salmon are marked by a small fatty fin just behind the dorsal. Trout vary in color, size, form, and in many other particulars. Overfed brook trout are very large." Along the north shore of the St. Lawrence and in Labrador waters, (even in Canada,) "overfed brook trout" are caught in nets and by hook and line, *weighing from two to five pounds*,—they are salted down and sold in the Canadian markets *by the barrel*. "There is quite a difference between the fat brook trout and those taken from the sea, (the latter are females, I think, and the males do not leave their native stream.) The salmon are very lean after spawning.

"In a hatchery keep the hatching box well supplied with a good supply of fresh water—it should be kept at a temperature of 47° to 50°. Build a gate over the stream, behind the box, to regulate the amount of water; dig a pond or ponds, plank them inside, lead the water into them from the stream, and lead off the waste water. In the hatching-house, each separate box should have a separate stop-cock to regulate the supply of water, and also a cover to keep the insects out of it. Trout and salmon deposite their eggs on a gravelly bottom and in rapid, running water. Do not keep them together, as they eat each others spawn and young. As regards time, the hatching of the young depends upon the temperature of the water. If the water be 50° the spawn will hatch in fifty days; and five days later for every degree lower. The eggs will sustain intense cold and yet survive. The young resemble greatly some of the fossil fishes. The trout lie helpless with an attachment of a large yolk sack for sometime before a vigorous growth begins; with salmon the time is not so long. Young fish are fed upon ox or calves' liver in a finely divided state. The enemies of both egg and young are numerous. While lying in the hatch-

ing box the eggs are attacked by a mould or fungus, which glues them together in a mass. To avoid this, cover the box with tar, charcoal, or asphalt varnish. Water insects must be watched and removed. Mice will eat both eggs and young if exposed. Keep the box covers closed, or provide them with springs, so that the light may be excluded. When once put into a stream the young will be rapidly destroyed by other fish, frogs, heron, and water snakes.

"Some fish do not run to the sea. The salmon does, and thereby gains its large size,—as no small fish of this species are found in the sea. In its natural waters, the eggs are laid at the head of some small stream, where the young may be found. They are then about four inches long with dark bars on their sides, and go by the name of *pars;* further down the river or stream are found larger fish, which have lost their bars and gained a silvery coating, these are called *smalts.* The pars change their features slowly, the smalts more rapidly, those which descend to the sea often feed so voraciously that they gain a pound a day.

"Shad are studied in this country. They belong to the herring group. When they return from the sea to spawn their stomach is almost empty yet they themselves are very fat. After spawning they return to the sea again, but often die of starvation before reaching it. Until 1867, no one had thought of rearing the young fish from the egg. Seth Greene succeeded, at South Hadley Falls, Mass., where he found the waters of the Connecticut River just fitted for his purpose. To keep them in the water and not loose them he constructed a floating box, but hatched only a few fish the first time. Then he made a box having no bottom, which he fastened with floats in the river. In this he hatched the fish in sixty hours. At first they were small and greatly resembled the larvæ of mosquitoes. When let into the stream they immediately sought the middle of the river. Trout and salmon seeking the banks. As they descended they

grew rapidly. In two years time they returned as *chicken* shad; perfect males and females, and marketable. They go down the river in September. They do not migrate, as many would suppose, but the fish from each river keep distinct. The fisherman tell, by the intensity of color, what waters they are from. They appear in Savannah, Georgia, in February; in Washington, D. C., in March; in Massachusetts, in June.

"The eggs of fishes differ in size. In the trout and salmon there are about 1,000 eggs to the pound; in shad, 30,000; in some larger fish, as many as 70,000. Some fishes cannot be bred artificially—it then becomes necessary to transfer live breeders. These generally lay their eggs, not in mass but singly. The fish themselves must be delicately handled, as a damage to their skins usually results in death. Black bass will grow to a weight of thirty-five to thirty-six pounds. They were transported from Saratoga Lake in 1850. They must be kept in water of a certain temperature, the water being frequently changed. Trout can be transported to a great distance. Fish are transported from water to water by fish-ways. The greatest enemy of the trout is the pickerel."

CHAPTER VIII.

Morse vs. Putnam on Evolution. The End.

It was during this second year's course at Penikese Island, that the lectures upon evolution by Professor Morse, and arguments against that theory by other of the professors, formed a distinctive feature of our instruction.

Professor Morse was evidently an ardent evolutionist,—at least one would judge so from his lectures and personal conversation upon the subject. He gave us many interesting talks upon it— and seemed to have no patience with any one who did not think as he thought, or believe as he believed, regarding it. Some of his oft-repeated and apparently pet expressions were: "As you culminate in any group, you find features similar to those of the higher vertebrates," or, "there are no forms but that, in their culmination, point to the vertebrates;" still again, "certain parts of the mollusks show a resemblance to man,—as, for example, the eye and nerve ganglion, protected by a covering, suggests the skull."

I well remember how once the professor illustrated the progression of animal life from the lowest invertebrate to the highest vertebrate by an admirable, systematic tree of trunk, branches, and twigs; even, shooting here and there all over the blackboard, and ended by declaring the precepts of the evolution of man from all this treey and twigy matter. Unfortunately, however, man was made to appear at the extremity of one of these insignificant branchlets. As a result—during the evening of the same day, the figure remaining upon the board during that time,—some mischievious person made, naturally enough as far as simple appearances went, a few additional branchlets to the limb of man with the words "man in 1900?"

One can imagine the scene which followed upon the discovery of the marks: the consternation of the professor, and the good-natured raillery of the scholars. But this did not deter him from further lectures upon the subject; or we, who listened, from asking ourselves, like Pilate of old "what is truth" in this matter.

Of course not all who heard his lectures fully agreed with Professor Morse in everything which he said,—in fact, I am of the opinion that the majority rather sided against than in favor of his theories; yet, personally, he was a great favorite with everyone, and was greeted with a perfect storm of applause whenever he appeared amongst us—nor will we soon forget the apparent interest and enthusiasm with which he always entered upon his subject,—nor was that interest weakened, in either instructor or pupil, to the end.

I will now give you the substance, as fully and as clearly as my notes will allow, of Dr. Morse's most important arguments in favor of the theories of evolution and natural selection. He began as follows:—

"I come before you tonight, to say a few words upon a subject quite foreign to my usual one—the molluscous branch of the invertebrate kingdom. It is one which I think ought to be presented to you in a fair way, as it is one which is now agitating the whole world. I will not ask you to believe the evidence to be set forth against your better judgments; but I ask your attention while I explain, and lay before you, the views which are held by those who are supporters of the evolution theory, and supporters of Mr. Darwin; and I think you will see that it is not so terrible a thing to suppose man originated from a branch of the lower or animal kingdom, or, in other words, from the ape, after all.

"It is well known that all animals, in some form or other,—either in their adult or in their embryonic stages—resemble other animals, higher or lower, in *their* adult or embryonic stages; and that all classes have

forms that are almost impossible to be separated from, or are intermediate between, the two kingdoms of nature: For instance,—many of the lower forms of *polyzoa* cannot be definitely separated from many of the *algæ* or seaweeds, which, at a certain period of growth, throw out free forms having small bodies with a tail at each end, and which move about freely in the water. Thus the two forms, the animal and the plant, are so similar that a definite study of each is absolutely necessary in order to separate them with any degree of satisfaction—if at all. Such a study has not as yet been made,—and, undoubtedly, when it *is* made, many errors in our belief concerning them will be corrected, if not our whole classification of them altered. Then, too, we have many animals in the insect or articulate branch, which insensibly run into each other and into others of other branches,—these are so closely allied as to be almost inseparable if not quite so. Now to what does all this tend?

"Many of the old scholars of science classified the animal kingdom in such a way that there were no intermediate forms—by placing the doubtful genera and species in separate and distinct groups; thus representing the whole animal and vegetable kingdoms by separate and distinct groups, also. But we see, now, that this is contrary to their general structure, and opposed to true classification. If we represent the old classification by a series of straight lines, we shall have a good illustration of the relation of the old orders (or, better, branches) to each other; or even if the lines are placed in an inclined direction, one line being above the other, we shall still have a very good representation of the way in which the animal kingdom was classified by the old writers,—though each writer represented them by a different number of branches and orders: one conceding seven branches and twenty-eight orders; and another, eleven branches and seventeen orders; and so on.

"As I have said before, we know that many genera run into each other in such a way that they are al-

most wholly indistinguishable from one another, perhaps quite so. We cannot place these doubtful forms in separate families,—for it will not only show that we have not tried to separate them and give them their true places, but that we have built up a false classification, that cannot stand because it has no foundation. Now! what we evolutionists claim is, *not* that these branches are distinct creations, created to puzzle the naturalist, but that they are diverging species from branches that insensibly run into each other, in the same way that two unparallel lines will, at some time, meet, however different they are at their extremities. Thus we think that the letter V should be the symbol of the evolutionist; thus you will see how one branch insensibly runs into another, and why it is we find no intermediate forms—why it is, also, that the 'missing link' of Darwin, as it is called, is an animal to be dreamed of rather than to be actually seen.

"Now to prove more completely this nearness of relation, this running of one group into another, let us take some division of the animal kingdom which it would seem impossible to connect with anything but itself. For instance—everybody knows a bird by its feathers. But, if we examine its skeleton, we find that it corresponds to a reptile standing upon two legs; with the front legs slightly modified to suit a different sphere of action, the long tail off—to effect a balance, and the head slightly altered to suit a change in food. Note, now, the result of investigation! An animal was found, some years since, with such truly reptilian characters, that even the best anatomists thought that it was a reptile. At first, all of the parts of this wonderful animal were not discovered; but, little by little, the remaining parts came to light, until the discovery of the head, by Professor Marsh, completed the skeleton. All of its characteristics, save one, were reptilian, and, but for that one, it would have been considered the skeleton of a reptile: In place of the four legs there was a

wonderful development of the two wings of a bird, slightly modified to suit the form of the animal, and from these wing-shaped structures proceeded actual feathers. There was the central shaft, the barbs, and the barblets clearly defined—leaving no doubt whatever as to the identity of the animal in question. It was a reptilian bird. And so we find two orders, or rather branches, which it seemed at first sight impossible *not* to distinguish, so running into each other as to present an animal possible to belong to either. A connecting-link, as we would call it, between the birds and the reptiles. What can this be but the development of the one into the other? Here we have a means of communication between the two branches, —but this is not all.

"Again, look at the embryonic stages of the bird and some of the higher reptiles, and you will find, that, at a certain stage, the young bird is, apparently, identical in structure with tbe young reptile. Place the two, at that stage, side by side, and you will fail to tell which is the bird and which the reptile. It is only at a further stage of the development that the characteristics begin to change, and the bird assumes the elongated beak, and the webbed toes, which, at a certain stage, are found in all bird embryos; the front legs then assume the form of wings, and the tail is lost. The reptile retains its peculiarities."

The professor here entered into a long and very scientific discussion, by which he considered it proven, beyond further, reasonable doubt, that "tarsal, true tarsal bones," existed in birds, and could be discovered, under medium powers of the microscope, in the embryo, at a certain stage of its development. This he affirmed, proved "another point of connection between the birds and the reptiles"

Again continuing, he says:—

"With a few exceptions, ante-evolutionists are merely species describers. They are careless of the fact that conditions and circumstances may alter growth;and are endeavoring to build up monumens for

themselves by describing new species. Now if evolution be true down will go their species." (The professor had been talking particularly of mollusks,—but whether of the *Unios* or of the *Land* shells, the notes do not state). "Look at the difference in the number of species abroad and in this country. In England they have been reduced to about forty; and an eminent naturalist has taken some dozen of these and, by subjecting them to different circumstances, actually reduced that number. If this can be done in a short period of time, what might we not expect in looking back for one or even two hundred thousands of years? Take the species in New England, some twenty; and then go to the western portion of the United States,—in Ohio, Tennessee, and the tributaries of the vast Mississippi—surrounded on the north by the Laurentian chain, on the east by the Alleghanies, and on the west by the Rocky mountains—one vast basin! and we find species living in the brackish pools of water that are identified with those living in the sea. In the fresh water we find living species that are identical with those living in the brackish water. These all go by different names, because found in different localities; but they are so absolutely identical that, if placed side by side it is impossible to separate them. This is true of a great majority of our species—so called. Now what is the cause? It is clear enough to my mind. The sea, formerly, filled this large basin, and, gradually receding, left those large rivers which, after being nourished by the rain for years, grew fresh retaining many of their old and more hardy forms of animal life from the ocean. These forms, in turn, gradually became changed so as to sustain life in brackish, and then in fresh water. This process of change of living to suit a difference of environment, can now actually be performed artificially with some of our species. Thus we find, that it is possible to take forms which if introduced directly into fresh water would be instantly killed, and by gradually modifying their circumstances, cause them to become actual

inhabitants of fresh water and, in the naturalists' estimation, new species.

"Professor Hooker took Alpine plants and brought them to the foot of the mountain upon which he found them, and, in a few years, actually succeeded in producing plants which, in every respect, differed from the originals, yet combining certain characters which proved them identical with a species of a wholly different name and genus. By and by the naturalist will be endowed with prophetic vision, as it were, and be able to tell *when* to expect certain modifications, and *where* to find them.

"Now in regard to protective coloring. What is it if not the way in which some animals are enabled to secure their prey and to guard themselves from their enemies. Look at an instance which I myself noted! A troup of small fishes were quietly swimming over some eel-grass when, suddenly, they took a quick turn and swam off in a different direction; then, seeing before them a bright, tin peach can, which had been thrown into the water, they separated and instantly darted off everywhere. Now what bothered me for a long time was the cause of their fright at the eel-grass,—and it was a long time before I discovered it. By accustoming my eyes to the water, and studying it intently for some time, I found, buried snugly in the grass and of just the same color, the form of an ugly old sculpin, who, as the fishes came over him, had gulped down some half a dozen of them to make a meal of. The sudden disappearance of so many of their comrades at once, was enough to terrify the ranks of any company. Of course they did not see their enemy until he had made victims of some of their number. Then the poor, innocent tin can must be instantly avoided for its glaring colors. If that is not an instance of protective coloring, what is?

"Then, too, the practical importance of the 'survival of the fittest' can be illustrated in this way: Suppose that there was but one cod fish in the word, and that it produced 9,000,000 eggs. All lived, and each

adult fish produced 9,000,000 more eggs. As a result of this increase, the world would soon be buried a thousand feet deep in cod fish. (Applause). But, as it is, they are being continually thinned out; only about one-half of the eggs laid are impregnated, scarcely one-half of these survive impregnation—one-half of this half are killed when very young by frogs and other fishes, and, during their whole growth, they are being continually lessened. Even when fishes (fishes of other species, I mean,) go down the rivers to the ocean," (the professor, doubtless, refers to salmon, shad, and other *river* fish,) there stands a great barrier of enemies through which all must pass; and think what few survive! No wonder that those are the sharpest, keenest, strongest, and best fitted to allude their enemies. The remark made concerning shells and their reduction in species, will also apply to fishes and other branches of the animal kingdom; and, contrary to what is stated by the non-evolutionists that the greater the amount of material we get the better we are able to separate species, I say—that by this we are the better able to condense species.

"De Candole accepted, at first, the complete yet complex classification of the oaks, as given by eminent botanists; yet even he admits that, given the same climate, temperatures, soil, and other circumstances which affect their growth, many species converge and finally meet.

"The divergence of species is going on all over the world, and what we want to do is to unite them as much as possible, and find out the truth in regard to them. If anybody can prove the theory of Mr. Darwin false by true facts, we are all ready to believe him."

The professor then spoke of the races and ages of man in the world, since its beginning, and instanced them as proof of the theory which he supported, namely, the "survival of the fittest." He next made a statement, which is the strong point of the whole theory, that: "Even if we look at it in a religious

point of view, what is more beautiful than to imagine us, in centuries and centuries of time, gradually growing better and better, stronger and stronger and more perfect, until, by the gradual growth and survival of the fittest, the best we have ultimately reaches full perfection. I think that the theory of evolution is the only one that will explain the peculiarities of our living organisms."

During the latter part of the session of the school, and after Professor Morse's lectures upon evolution, we had a few words upon the subject, though in a different direction, from Professor Putnam. Mr. Putnam is as valid and sound a reasoning non-evolutionist as is Mr. Morse an ardent and theorizing evolutionist. I well remember how, one day, the former stopped suddenly in a lecture upon fishes—the *myxine* being the subject of his talk—and after looking at us for a few moments with one of his tired yet kindly smiles, said:—

"As this is my last lecture, and as so much has been said already concerning the theory of evolution, and that in its favor, I think it but fair that a few things should be said to you upon the other side, and I propose, this morning, to give you a few facts that have led me to place myself on that side:—

"Of the three lowest branches of the vertebrate kingdom, we have represented the lancets, the myxine, and the lampreys. Now! if the theory of evolution is correct, we would naturally expect to find these three groups differing only in such a way that one is the higher power of the other; but, what *do* we find? In the lampreys, the highest of the three classes, we find the eggs forming in the oviduct, and falling free into the abdominal cavity. In this little myxine, besides other peculiarities, there are *no* oviducts."

Here the professor explained in full the formation of the egg, and the other peculiarities of its growth, etc., and said: "Thus we have an animal next higher than the amphioxus, (the lowest form amongst the vertebrates, and cited by many as the connecting-

link between back-bone and non-back-bone life,) giving characteristics similar to those of the higher groups of selachians and even some of the higher orders of animals themselves, though, in general development, far inferior to the lampreys even, which are higher in so many respects. Now this is only *one* instance of *the distinctive character of individuals.* The evolutionists would probably say, that this simply formed a branch which refused to unite; but, to my mind, that hardly accounts for the fact: It hardly seems possible that there should be found so many branches, as there really are, refusing to unite."

Here, Professor Putnam's remarks were cut short by some call in another direction, and he left the island before completing the talk which he had promised us, and had, so far, so ably and so significantly begun.

It is, without any doubt, such facts as these: species of a known and definitely lower group possessing so many of the characteristics of the higher animals, that cause the *working* naturalists to rebel against the ardor of his more sanguine brother scientist, who first pronounces his theory, and then endeavors to fit to it or explain away from it the facts that come within his reach. Without doubt Agassiz saw far enough into Nature's realities to avoid theories and useless controversies. *He* endeavored to let his investigations refute theories based upon false premises.

Professor Morse, when he said that anti-evolutionists were, "with a few exceptions, merely species describers," forgot the tremendous concession thereby made to those same "non-evolutionists," since one of the evolutionist's grand theorems is, that "no one has as yet even defined what a species is." The non-evolutionists do *not* seek to make species, genus, family, orders, branch, and such like divisions of the animal kingdom synonymous with the term individual, as do the evolutionists, though they, the former, *do* believe in the universal oneness—if we may so call it—of matter, as well as in its indestructibility.

As, at length, I draw near to the conclusion of my

task—a most delightful and pleasant task, I admit—of sketching, for my readers' benefit, the history of Penikese Island; what crowds of memories press around and upon me: Memories that I have written about and memories that I have not written about, but which yet hover around and about places hallowed by the mysterious ever present presence of him whose memory is dear to so many. As I draw near to the conclusion of my task, I say, I fear for both what I have written and what I have not written. What I have written, that it ought not to have been written, and what I have not written that it ought to have been written. Yet, such as it, it must stand. My object has been *not* to transcribe to you a dull, dry, monotonous diary of facts—difficult to digest,—but rather, by a taste of our pleasures and enjoyments, to leave the mind of the reader in a state of anticipation and desire to explore Nature and the mysteries of Nature ;for, thereby, is gained profit, delight, wonder, satisfaction, and everything that is in harmony with our being and our eternal welfare. We come nearer to our fellowman and closer to our God, in a study of all creation and of created objects; and so, at least thus I believe, do we fulfill better our mission here upon the earth, to "know even as we are known."

During the session of the school the Agassiz Natural History Club met weekly for discussion of scientific subjects, and for suggestions as to the work going forward and to be pursued. Here teacher and pupil met upon equal footing and freely discussed all questions. Even practical Professor Meyer became eminently scientific and, at a suggestion, turned his physics to the settling of many an otherwise abstruce problem. Of one in particular, namely, that of testing, by actual experiment, if insects could hear with their antennae—that delicate organ of the functions of which we know so little. He so arranged a male mosquito, upon one of the slides of his lantern, that he threw its image, enlarged several thousand times, upon a large white sheet. Then he vibrated tuning forks near to

them, and, by noting the antennae of the insect, we were enabled both to propound and to answer questions that would otherwise have puzzled the ablest scientists.

Thus passed our days! The last, as prolific of interest as the first. Alas! They no longer exist, save in the memory of teacher and of pupil.

But a few words more, and the gleam of the candle, growing fainter and fainter, leaves darkness once again. Darkness, I say; yes, darkness—save for the memory of that gleam: A. RECOLLECTION.

The Agassiz Society of Natural History met, for the last time, in the lecture room, Monday evening, August 31st.

Its business was simply "to consider the resolution drawn up by the committee," appointed for this purpose at a previous meeting, "on the death of Professor Louis Agassiz." It was accepted by the club, "as an expression from the club, of their sympathy with the friends of, and their love and respect for, the professor taken from among them so suddenly." The resolution was as follows:—

"WHEREAS, it has been decided that we, the members of the Agassiz Natural History Club, attempt an expression, in resolution, of our feelings upon the departure of our beloved leader, and our sympathy in this great bereavement with the many who have learned to speak his name in the accents of tenderness and affection, therefore, it is

"RESOLVED, That in the close of the grand life of Professor Louis Agassiz we mourn the loss of a good citizen, an earnest student, a great teacher, a faithful friend, a true Christian, a lover of his fellowmen and of God; that, though words utterly fail to express the estimation in which we hold his noble example and teachings, we may yet show to the world our appreciation of the light that is gone in our works and lives, and that from the bottoms of our hearts we do sympathize with all to whom his memory is dear."

On the 14th of December, 1878, in the sixty-sixth year of his age, Professor Agassiz passed away.

A boulder from his beloved Alps alone marks his resting-place at Auburn, city of the dead:—while lilies bloom about him (white lilies-of-the-valley, are they); the birds and insects make music above him; and, while the world endures, his memory shall not fade.

The story is ended by the recent notice of the complete destruction, by fire, of the school buildings, which can now be viewed by picture only. Alas, indeed! Penikese Island is but a memory!